/ PHYSICS    YEARLY  2008  Y11 : JRAHS

**PART A**    20 marks    Each question worth 1 mark.  Answer on the Answer Grid provided.

1.  A laser light beam of wavelength $6 \times 10^{-7}$ metres is shining on a mirror as shown in the diagram, which is not drawn to scale.   The frequency of the reflected beam and angle of reflection will be closest to:

    a)    $6 \times 10^{-7}$ Hz  and   25 degrees

    b)    $5 \times 10^{14}$ Hz  and   45 degrees

    c)    $5 \times 10^{14}$ Hz  and   65 degrees

    d)    $5 \times 10^{14}$ Hz  and   30 degrees

    
    mirror
    $25^{0}$  $65^{0}$
    laser beam
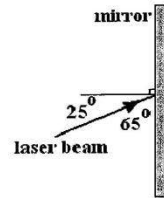
2.  Below are four statements about the accretion of galaxies and stars following the "Big Bang".  Which of the statements is incorrect?

    a)    rapid expansion of the universe which leads to warming the universe
    b)    subsequent loss of kinetic energy
    c)    gravitational attraction between particles
    d)    lumpiness of the gas cloud leading to gravitational collapse

3.  Which of the following astronomers is historically credited with first documenting and supporting the heliocentric model of the universe?

    a)    Ptolemy
    b)    Aristotle
    c)    Galileo
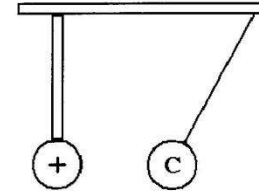    d)    Hubble

4.  An electron with charge $1.6 \times 10^{-19}$ coulombs is placed in an electric field of 300 Volts/metre as shown in the diagram below.   Ignoring gravity, the electric force on this electron will be closest to:

    a)    $4.80 \times 10^{-17}$ N   left

    b)    $4.80 \times 10^{-17}$ N   right

    a)    $0.53 \times 10^{-21}$ N   left

    a)    $0.53 \times 10^{-21}$ N   right

    
    $\overline{E} = 300$ V/m
    electron
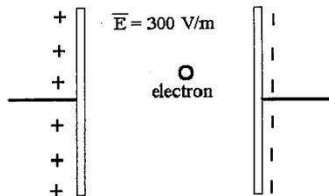
5.  A metal sphere C is attached to an insulated stand by a thread, as shown below.  A second metal sphere is also present, but this sphere is fixed in place and cannot move.  This second sphere has a positive charge.   Because sphere C is attracted to the positive charge, it can be concluded that sphere C:

    a)    has negative charge

    b)    has a net positive charge.

    c)    has negative charge or is neutral

    d)    must be neutral

    
    +    C

6.  Which of the following astronomers is historically credited as first documenting and supporting the Big Bang Theory of the universe?

    a)    Ptolemy
    b)    Freidmann
    c)    Einstein
    d)    Hubble

7.  In the diagram below each lamp has a resistance of 100 ohms.   Compared to the brightness of lamp 1, the brightness of lamps 2 and 3 can best be described as:

    a)    both lamps 2 and 3 each have brightness equal to the brightness of lamp 1
    b)    both lamps 2 and 3 each have brightness 1/3 x the brightness of lamp 1
    c)    both lamps 2 and 3 each have brightness 1/2 x the brightness of lamp 1
    d)    both lamps 2 and 3 each have brightness 1/4 x the brightness of lamp 1

    
    Lamp 1    Lamp 2
    Lamp 3
    12 Volts DC
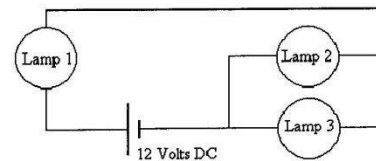
8.  The total resistance and total current flowing in this circuit above is closest to:

    a)    300 ohms,        0.04 amps
    b)    100 ohms,        0.12 amps
    c)    150 ohms,        0.08 amps
    d)    300 ohms,        0.08 amps

9. Consider the circuit below which shows one ammeter ( A ) and four voltmeters ( V ). The voltmeter that is not placed correctly in the circuit is:



18 volt battery

$A_1$   3 Ω   $V_4$   $V_3$   9 Ω   6 Ω   $V_1$   $V_2$
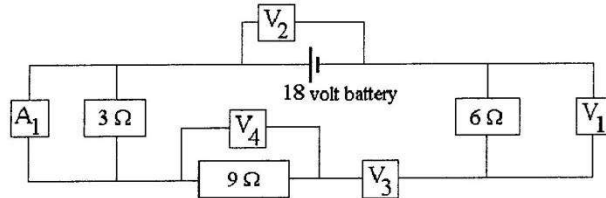
a) $V_1$
b) $V_2$
c) $V_3$
d) $V_4$

10. A household in Australia uses an electricity supply of 240 volts AC. If they switch on the following appliances for the times shown in the table, then their total energy consumption will be closest to:

| appliance | power ( watts ) | time ( minutes ) |
|---|---|---|
| heater | 2400 | 180 |
| TV | 200 | 600 |
| computer | 800 | 1200 |
| lamp | 100 | 600 |
| another lamp | 100 | 30 |
| another lamp | 100 | 16.666667 |
| iron | 1500 | 60 |

a) 1,666,667 J
b) 5,200 J
c) 2,687 J
d) 100,000,000 J

11. For yellow light, the refractive index of glass is 1.6 and the refractive index of water is 1.2. Which of the following statements is correct?

a) The wavelength of yellow light is longer in glass than in water.
b) For the same angle of incidence, yellow light is refracted more by water than glass.
c) Total internal reflection cannot occur when yellow light travels from water to glass.
d) Light travels faster in glass than in water.

12. The following quote is most likely describing:

" …with the charge carriers moving backwards and forwards periodically. "

a) a uniform electric field distribution
b) alternating current flow
c) a new form of deep space weapons system
d) direct current flow

13. The picture shows a microwave uplink communications antenna. This antenna is an application of reflection from which one of the following surfaces:

a) a plane surface
b) a concave surface
c) a convex surface
d) the ionosphere



14. The relative magnitude of a star is related to its:-

a) temperature.
b) luminosity
c) distance away from the observer
d) all of the above

15. All of the following devices are electrical safety features used in the home. Which one of these features is the first line of defence, directly protecting you from being electrocuted by every electrical appliance you use?

a) fuses
b) circuit breakers
c) double insulation
d) earthing

16. Which diagram correctly shows the direction of the magnetic field ( represented by dots and x's ) around this current carrying loop of wire?
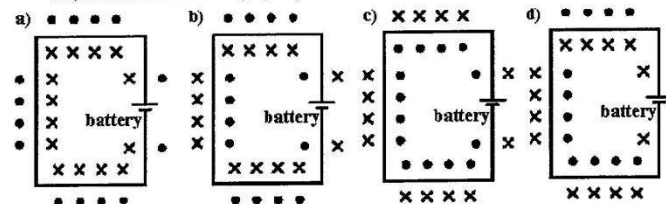
17. It would be generally true to say that, in an electrical circuit:-
    a)    ammeters and voltmeters have zero or very low internal resistance
    b)    ammeters have high internal resistance, voltmeters have zero internal resistance
    c)    ammeters and voltmeters have very high internal resistance
    d)    ammeters have low internal resistance, voltmeters have high internal resistance

Questions 18, 19 and 20 refer to this Hertzsprung-Russell diagram



18. The diagram can be used to classify our sun as a:

    a)    main sequence, spectral class G star.
    b)    white dwarf
    c)    6000 degree Kelvin supergiant
    d)    remnant of a black hole

19. The diagram implies that our sun will:

    a)    remain unchanged when compared to other stars in the universe
    b)    move to the right and down developing into a red dwarf
    c)    move through the red giant, main sequence, white dwarf stages
    d)    rapidly become a blue supergiant

20. The diagram implies that:

    a)    white dwarfs are cooler and much more luminous than our sun
    b)    hot subdwarfs emit similar coloured light to our sun
    c)    cooler stars such as blue supergiants are very bright
    d)    cooler stars such as red dwarfs emit little energy in the blue and UV regions

**End of Multiple Choice Section A............................ Go on to Section B**

## PHYSICS DATA SHEET

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|---|---|
| Mass of one electron ( $m_e$ ) | $9.109 \times 10^{-31}$ kg |
| Mass of one neutron ( $m_n$ ) | $1.675 \times 10^{-27}$ kg |
| Mass of one proton ( $m_p$ ) | $1.673 \times 10^{-27}$ kg |
| Charge on one electron ( q ) | $-1.602 \times 10^{-19}$ C |
| Speed of sound in air | $340$ m s$^{-1}$ |
| Speed of light in a vacuum ( c ) | $3.0 \times 10^8$ m s$^{-1}$ |
| Magnetic force constant ( $k \equiv \frac{\mu_o}{2\pi}$ ) | $2.0 \times 10^{-7}$ N A$^{-2}$ |
| Universal Gravitational constant ( G ) | $6.67 \times 10^{-11}$ N m$^2$ kg$^{-2}$ |
| Planck's constant ( h ) | $6.626 \times 10^{-34}$ J s |
| Rydberg's constant ( $R_H$ ) | $1.097 \times 10^7$ m$^{-1}$ |
| Atomic mass unit ( u ) | $1.661 \times 10^{-27}$ kg $931.5$ MeV/c$^2$ |
| One electron volt (1eV) | $1.602 \times 10^{-19}$ J |
| Specific heat capacity of water | $4.18 \times 10^3$ J kg$^{-1}$ K$^{-1}$ |
| Density of water | $1.0 \times 10^3$ kg m$^{-3}$ |
| Earth's radius | $6.380 \times 10^6$ m |
| Earth's gravitational acceleration ( g ) | $9.8$ m s$^{-2}$ |
| Earth's mass | $6.0 \times 10^{24}$ kg |
| Wien's constant (W) | $2.89 \times 10^{-3}$ m.K |
| One parsec | $3.26$ light years |

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**Part B.**   **Extended answer questions.**    **Student ID:** ...........................................
**Answer in the space provided**    **(46 marks)**

21.   A 1.0 m length of copper conductor, with diameter 0.005 m is carrying 25 A of current. A student measures the temperature of this conductor and finds that the temperature is 20°C. The student then makes the following single changes to the conductor, keeping the other variables at their initial values, and measures the change in current flow.

Given that the Voltage across the conductor also remains constant, <u>describe</u> how each change will affect the current flow <u>and justify your answer</u>.

( 1 mark awarded for clarity of communication.....skills 13.1 a)          ( 1 mark )

a)   The length of the conductor is increased to 3.0 m.          ( 1 mark )

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b)   The diameter of the conductor was increased to 0.010 m.          ( 1 mark )

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c)   The temperature changed to 25°C          ( 1 mark )

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d)   The conductor was replaced by a gold conductor.          ( 1 mark )

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22.   Sketch the electric field in each of the following individual cases.          ( 3 marks )



a) two positive charges          b) parallel plates          c) single negative charge
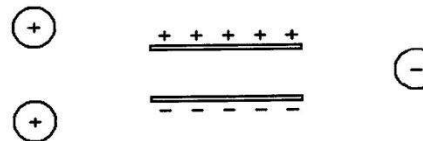
23. Study the circuit opposite.        (5 marks)

a)    Calculate the total resistance of this circuit.  ( 1 mark)

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b)    Calculate the total current flowing in the circuit.

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c)    Calculate the potential difference between points A and B.        ( 2 marks)

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d)    Find the total energy dissipated by the 8 ohm resistor in a time of 2 minutes.        ( 1 mark)

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24.    The diagram below represents a non uniform electric field.

a)    Is position P at a higher or lower electric potential than position Q ?    ( 1 mark)

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b)    Explain your answer to a) above.        ( 2 marks)

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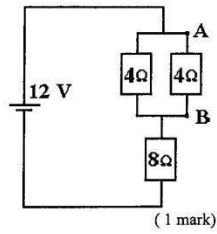
25.    Mobile phones transmit back to the local cell tower using microwave transmissions.

a)    Remote controls often communicate to the TV or video by infra-red radiation.  Outline one reason why infra-red radiation is not suitable for mobile phone communication.   ( 1 mark)

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b)    Outline two major reasons why communications companies use microwave radiation for mobile phones to transmit back to the local cell tower.        ( 2 marks)

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26.    Explain how observations of the light spectra of light from distant galaxies gives evidence for the Expanding Universe Theory.        ( 3 marks)

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27. A teacher sets up a demonstration to show the magnetic field around a bar magnet. The magnetic field is not visible to the students, so some equipment will be required to show that it is there.

a) In the space below, draw and label the equipment that will allow the teacher to demonstrate the presence of a magnetic field around the magnet. (2 marks)

| N | S |

b) In the space below, draw a labelled diagram showing the expected results that will allow the teacher to demonstrate the presence of a magnetic field around the magnet. (1 mark)

| N | S |

28. Fused silica has a refractive index of 1.46.

(a) Calculate the critical angle of fused silica. (1 mark)

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(b) A ray of light is incident internally on the surface of fused silica at an angle of incidence of 65°. By referring to part (a) above, describe the subsequent path of the ray. (2 marks)

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29. Complete this diagram of a fibre optic to show how light travels through it, undergoing total internal reflection as it goes. (1 mark)

30. A vertical radio transmitting antenna is sending out radio waves equally in all directions. The wave fronts are expanding in a circular pattern away from the antenna. If the radiation intensity being received at a distance of 3.4 km away is 0.035 $W\,m^{-2}$, calculate the intensity at a distance of 11 km away. (2 marks)

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31. In a Physics Practical Test a student is given a power pack, an ammeter, a switch, three light bulbs and as many leads as required.

a) Draw a clear, labeled, circuit diagram showing how all components could be connected, so that the ammeter measures the total current flowing from the power pack, and the three lights are all in series. (2 marks)

b) Draw a clear, labeled, circuit diagram showing how all components could be connected, so that the ammeter measures the total current flowing from the power pack, and the three lights are all in parallel. (2 marks)

32.  a)   Discuss one suitable way in which electricity can be provided to a remote location, where that location has no access to wood or fossil fuel, for example 5 people living on a sailboat in the middle of the Pacific ocean.          ( 2 marks )

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b)   Discuss one suitable way in which electricity can be provided to a remote location, where that location has limited sunlight, for example 5 people living in an ice cave in the Arctic Circle.          ( 2 marks )

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