JAMES RUSE AGRICULTURAL HIGH SCHOOL

PRELIMINARY EXAMINATION

2003

PHYSICS

General Instructions:
- Reading Time – 5 minutes
- Working Time – 2 hours
- Board-approved calculators may be used
- Write using blue or black pen
- Draw diagrams using pencil
- A Data Sheet and Periodic Table and Formulae Sheets are provided at the back of this paper

Total marks: 65
This paper has two parts, Part A and Part B

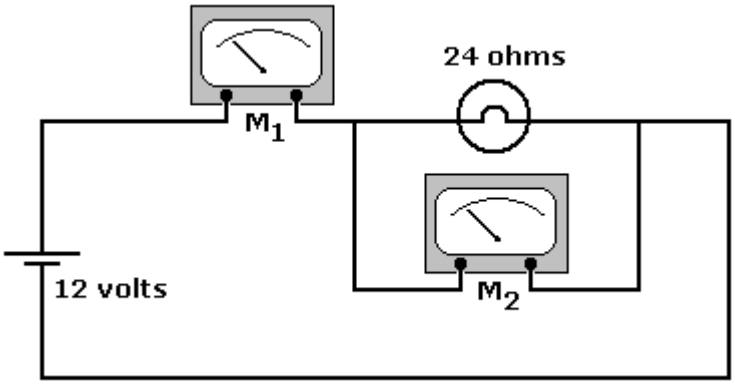
Part A Total marks: 15
. Attempt Questions 1 – 15
. Allow about 30 minutes for this part

Part B Total marks: 50
. Attempt questions 16 – 29
. Allow about 1 hour and 30 minutes for this part

PART A Total marks: 15 Allow about 20 minutes for this part

Select A, B, C or D as the best answer in the multiple choice answer sheet.

1. The readings on the ammeter M1 and the voltmeter M2 will be:



a) 2 amps and 12 volts
b) 0.5 amps and 12 volts
c) 12 volts and 2 amps
d) 0.5 amps and 6 volts

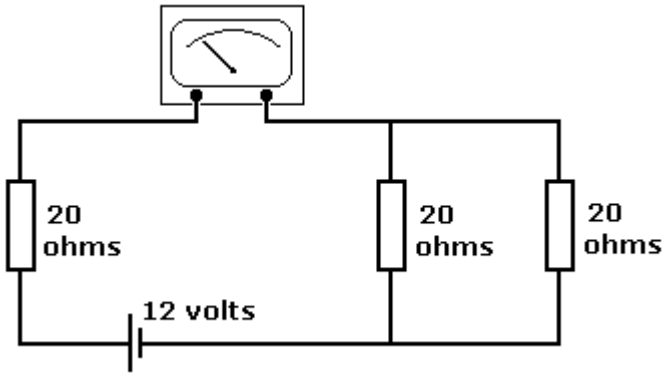
2. The resistance of a piece of conducting material depends on a number of factors. Which of the following conductors will have the lowest resistance?

a) 2 metres of hot thin steel wire
b) 2 metres of cool thin copper wire
c) 1 metre of cool thick copper wire
d) 1 metre of hot thick steel wire

3. A charged particle of mass 3.2×10^{-19} coulomb is released from rest in an electric field. If the electric field is uniform and has a strength of 1000 Newtons/Coulomb, then the electric force on the charged particle will be closest to:

a) 3.2×10^{-19} Newtons
b) 3.2×10^{-16} Newtons
c) 1.6×10^{-19} Newtons/Coulomb
d) 3.2×10^{-19} Joules

4. The current flowing through the ammeter will be closet to:

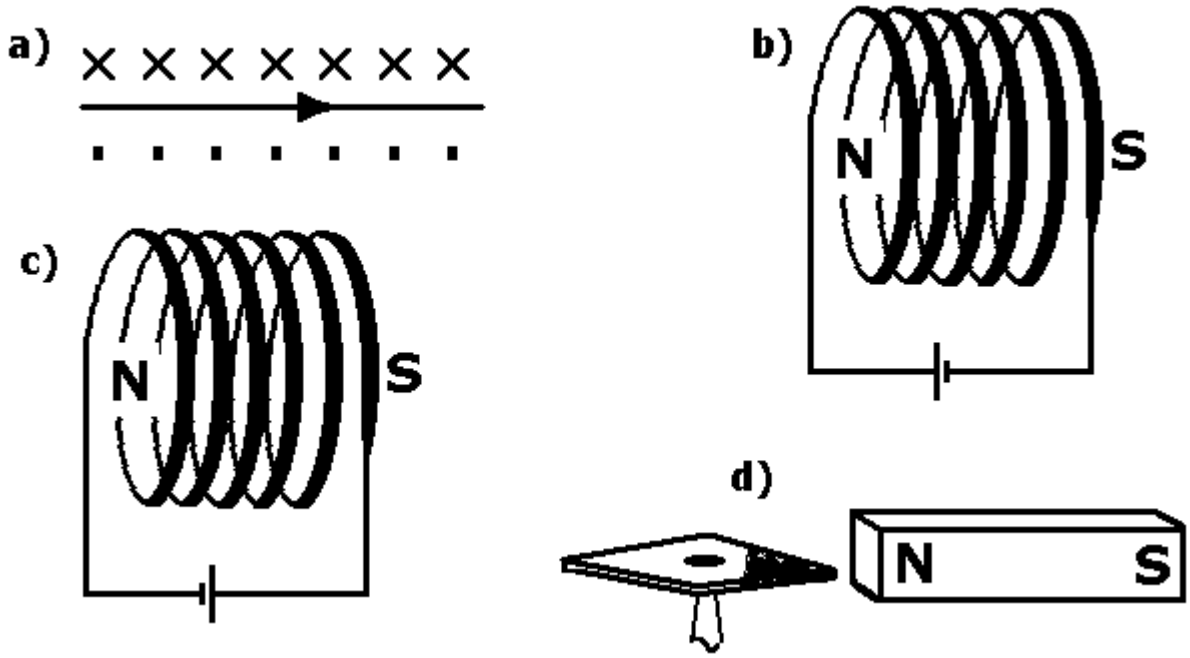


a) 2.6 A
b) 4.0 A
c) 0.4 A
d) 0.2 A

5. Which of the following is an example of total internal reflection?:

a) signals from three satellites reaching a Global Positioning Receiver
b) microwaves travelling between communication towers in Sydney
c) light striking a convex polished metal mirror
d) light travelling through optical fibres

6. Which diagram correctly shows the orientation of the magnetic field?



7. A TV repair person needs a 15 ohm resistor, but does not have one. There are lots of 10 ohm resistors available. Which one of the following 10 ohm resistor combinations will give a total resistance of 15 ohms?

a) three 10 ohm resistors in series
b) two 10 ohm resistors in series, connected in series with another two resistors in parallel
c) five 10 ohm resistors in parallel
d) one 10 ohm resistor in series with another two resistors which are in parallel

8. Our sun is currently considered to be:

a) a supernova
b) a main sequence star
c) a red giant
d) a white dwarf

9. The correct definition for power is:

a) the change in potential energy per unit charge
b) the direction of the force on a very small north magnetic pole
c) the rate at which energy is transformed from one form to another
d) the ratio of voltage to current

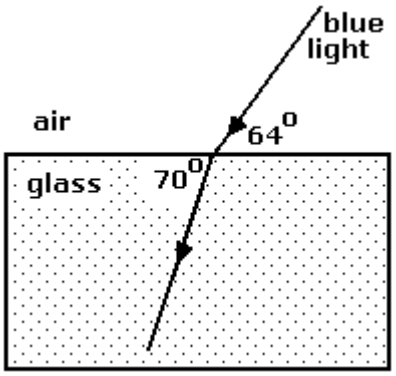
10. The intensity of light, measured at a distance *d* is found to be *I*. At a distance of *4d* the intensity would be closest to:

a) *I* / 16.
b) *I* / 8
c) *I* / 4
d) *I* / 2

11. Which of the following include models of the solar system?

a) Galileo's model whereby planetary orbits are ellipses around the sun
b) A sun centred heliocentric model and an Earth centred geocentric model
c) A Copernican model where everything revolved in concentric circles around the earth
d) Brahe's model where all the planets revolved around the earth and the earth revolved around the sun

12. A beam of blue light with wavelength 4.8×10^{-7} m passes into a glass slab as shown in the diagram. The angle of refraction in this situation is:



a) 70 degrees
b) 64 degrees
c) 20 degrees
d) 26 degrees

13. The spectral classes of four different stars are given as follows in an Astronomy handbook. Which of the stars would have the hottest surface temperature?

Name	Spectral Class
Sirius	A 0
Alpha Centauri	G 0, K 5
Beta Crucis	B 1
Polaris	F 8

a) Sirius
b) Alpha Centauri
c) Beta Crucis
d) Polaris

14. The universe is believed to have begun from a single point where all the energy and matter of the universe existed in one place. Which of the following answers gives the correct order (from early to most recent) for the events in the formation of the universe, as we know it now?

a) Universe cooled to 10^{27} K, quarks and electrons formed, protons and neutrons formed, temperature cooled to 10^{10} K, thermonuclear fusion began, temperature cooled to 3000 K and radiation was free to move through the universe.

b) Universe cooled to 10^{27} K, protons and neutrons formed, quarks and electrons formed, , temperature cooled to 10^{10} K, thermonuclear fusion began, temperature cooled to 3000 K and radiation was free to move through the universe.

c) Universe cooled to 10^{27} K, quarks and electrons formed, radiation was free to move through the universe, protons and neutrons formed, temperature cooled to 10^{10} K, thermonuclear fusion began, temperature cooled to 3000 K.

d) Universe cooled to 10^{27} K, quarks and electrons formed, protons and neutrons formed, temperature cooled to 10^{10} K, thermonuclear fusion began, temperature cooled to 3000 K.

15. Which of the following is a correct statement for the law of reflection?

a) the speed of a wave changes as it changes mediums, in proportion to the refractive index

b) light waves will always totally internally reflect when the refractive index of the second material is lower than the first

c) the angle of incidence equals the angle of reflection

d) waves spread out as they travel through a narrow opening

------- end part A -----

PART B Total marks: 50 Allow about 1 hour and 40 minutes for this part

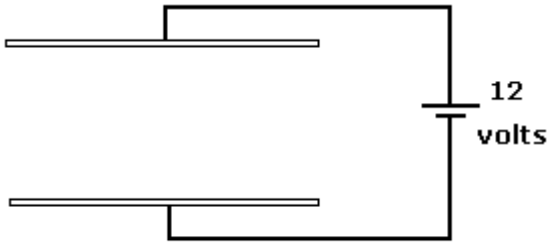
Answer questions 16 – 29 in the answer space. Show all relevant working and calculations.

16. Circuit breakers and fuses are used to protect humans in their homes from the danger of electric shock.

    a) What is one advantage that a circuit breaker has over a fuse? (1 mark)

    b) Discuss the different effect AC power and DC power has on the muscles of the body. (2 marks)

17. a) On the diagram in the answer space sketch the electric field lines between the plates. (1 mark)



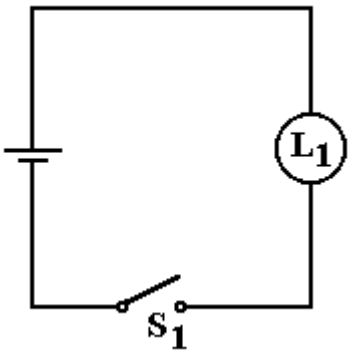
    b) On the diagram in the answer space, sketch the magnetic field lines between the magnets. (1 mark)

c) Outline one way in which magnetic fields or magnets are used around the home. (1 mark)

18. Using coal as an energy source has changed in the last two hundred years. Coal was originally used in fires to heat the home. Give **two** ways in which this has changed in the last 200 years. (2 marks)

19. An electric heater rated at 2400 watts is used for 10 hours. If electricity costs 25 cents per kilowatt-hour, how much will this cost? (2 marks)

20. A student sets up this circuit. The voltage of the battery is 12 volts and when the switch S1 is closed, a current of 3 amps flow around the circuit. The student notes the brightness of lamp L1.

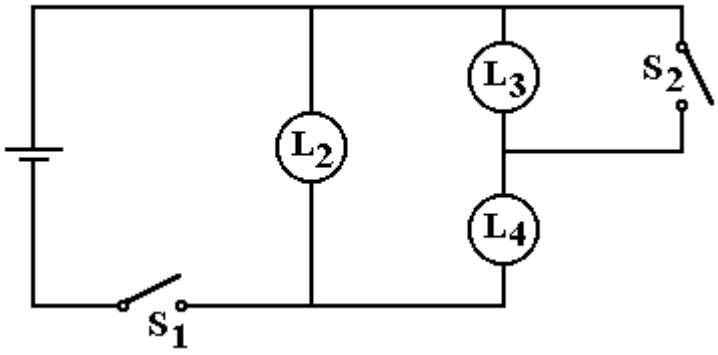


a) Calculate the resistance of lamp L1. (1 mark)

b) Calculate the electrical power used by lamp L1.(1)

The student then changes the circuit.

All lamps are identical to the lamp L1.



c) Switch S1 and S2 are closed. Compare the brightness of each lamp to the brightness of L1 in the original circuit. (dimmer, same or brighter) ? (3 marks)

21. Identify the difference between conductors and insulators. (2 marks)

22. a) Sketch a Hertzsprung – Russell diagram and label the axes. (3 marks)

b) On your diagram indicate the regions of: (3 marks)
   i) main sequence stars
   ii) red giants
   iii) white dwarfs

c) Also on your diagram indicate the position of our sun (G 2) (1 mark)

23. Define accretion and briefly show how it helps explain the formation of stars and galaxies.(2)

24. a) List one of the two assumptions made by Friedmann about the universe. (1 mark)

b) Friedmann proposed a model to explain the fate of our universe. This "closed universe model" is one of three proposed possible explanations. The other two are the "flat universe model" and the "open universe model".

Choose **one** of these models and explain how it works. (2 marks)

25. a) Briefly name or describe one form of evidence that supports the big bang theory. Explain how this evidence supports the big bang theory (2 marks)

b) Briefly name or describe a second form of evidence that supports the big bang theory. Explain how this evidence supports the big bang theory (2 marks)

26. a) A light ray travelling in a vacuum, has a wavelength of 5×10^{-7} m. The ray enters a glass slab that has a refractive index of 1.5. Calculate the wavelength of the light in the glass. (2 marks)

b) Another light ray travelling in a vacuum, has a wavelength of 5×10^{-7} m. The ray enters a perspex slab that has a refractive index of 1.3. Calculate the wavelength of the light in the perspex. (1 mark)

c) Calculate the ratio of the speed of the light ray in the glass to the speed of the light ray in the perspex. (1 marks)

27. Modern communication methods rely on electromagnetic radiation and digital storage.

a) Identify two communication wavebands within the electromagnetic spectrum. (2 marks)

b) Identify two types of communication data that are stored in digital form. (2 marks)

28. A ray of light, travelling in air, is incident on a horizontal glass surface at an angle of incidence of 30 degrees. If the refractive index of the glass is 1.5, find the angle of refraction of the light ray in the glass. (2 marks)

29. Your task is to find the relationship between resistance and current, when the voltage across a resistor is held constant, using the data given.

	Resistance R (ohms)	Current I (amps)
	2	12.0
	4	6.0
	6	4.0
	10	2.5
	12	2.0
	16	1.5
	20	1.2

a) Graph these results with the independent variable (resistance) on the horizontal axis. (3 marks)

b) What does your graph suggest about the relationship between resistance and current? (1 mark)

c) Using graphical or algebraic means, support the suggestion, made in (b) above. (2 marks)

d) What was the constant voltage used in this experiment? (1 mark)

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