



2005
Year 11
Yearly Science Examination
Hurlstone Agricultural High School

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, Periodic Table, and Formulae Sheets are provided at the back of this paper

Write your name below.

TIC: Mr Robson

All sheets must be handed in separately at the end of the examination.

Name _____

Tick Coombes Pitt Robson

Marks

Total marks (70)

This section has two parts, Part A and Part B

Part A

Total marks (10)

- Attempt Questions 1 – 10
- Allow about 20 minutes for this part

Part B

Total marks (60)

- Attempt Questions 11 – 28
- Allow about 1 hour and 40 minutes for this part

Part A**Use the multiple-choice answer sheet.**

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9

(A) (B) (C) (D)

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) (B) (C) (D)

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word correct and drawing an arrow as follows:

(A) (B) (C) (D)

correct
↓

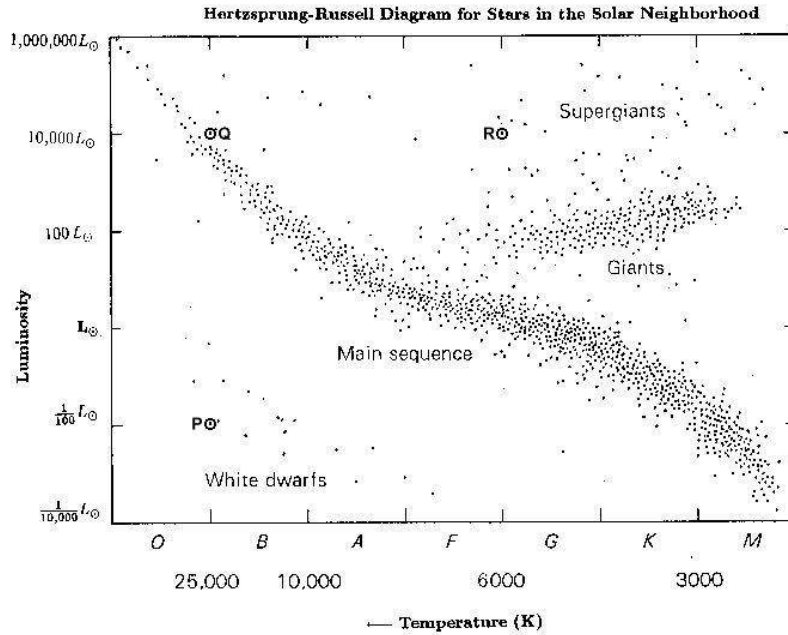
Total marks (10)

Attempt Questions 1 – 10

Allow about 20 minutes for this part

- Which of the following best describes the contribution of Isaac Newton to astronomy
(A) All planets orbit the sun with velocities proportional to the radius of orbit.
(B) All planets orbit the sun due to the force of gravity.
(C) All planets orbit the sun in elliptical orbits.
(D) All planets orbit the sun with an orbital period proportional to the radius of orbit.
- An astronaut takes a set of bathroom scales to the Moon. When he stands on the scales on the surface of the Moon the scales read 10 kg. The acceleration due to gravity on the Moon is $1/6^{\text{th}}$ of that on the surface the Earth, the weight of the astronaut is on Earth is closest to
(A) 60 kg
(B) 588 kg
(C) 588 N
(D) 98 N

The next two questions refer to the Hertzsprung – Russell diagram shown below



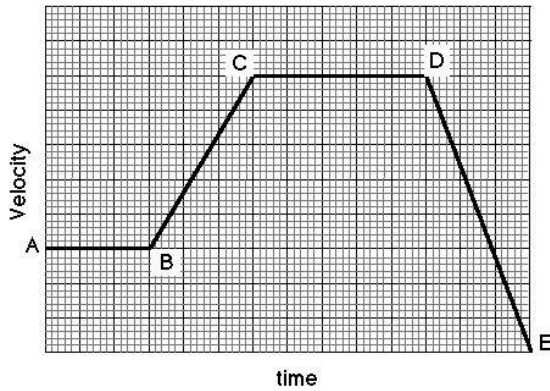
3. Identify the statement below that best compares a red giant with a white dwarf.
 - (A) Red giants are much hotter and more luminous than a white dwarf.
 - (B) Red giants are much hotter but less luminous than a white dwarf.
 - (C) Red giants are much cooler and less luminous than a white dwarf.
 - (D) Red giants are much cooler but more luminous than a white dwarf.

4. Identify the star with properties most closely matching the star located at position Q.

Answer	Radius of star	Colour	Temperature
(A)	Large	White	Hot
(B)	Large	Red	Hot
(C)	Small	White	Hot
(D)	Small	Red	Cool

5. The definition “The change in potential energy per unit charge moved between two points” best applies to which of the following quantities?
 - (A) potential difference
 - (B) power
 - (C) current
 - (D) resistance

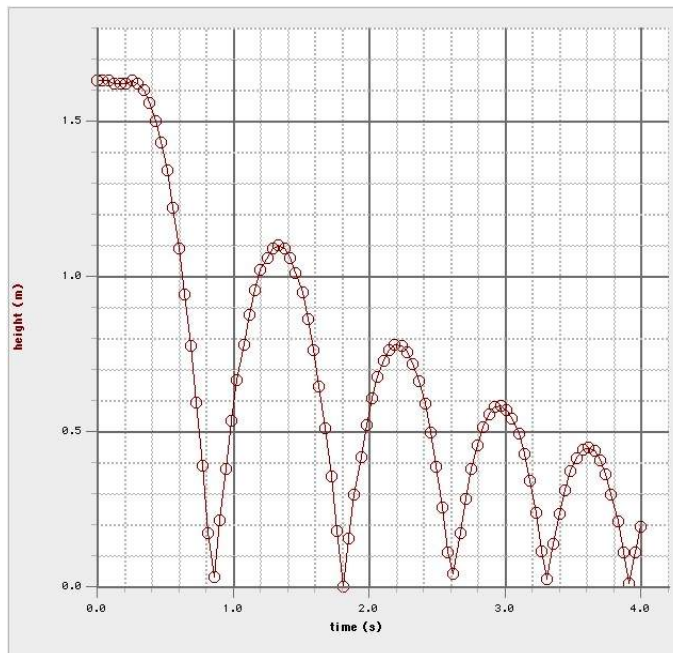
6. The following graph represents the motion of a car during a journey in a straight line.



Between which of the following points was the car moving with the greatest acceleration?

- (A) A-B
 - (B) B-C
 - (C) C-D
 - (D) D-E
7. The graph shows information about the motion of a basketball that was dropped from a stationary position. The graph shows the height of a ball above the the ground. The graph was produced using data that was obtained with an electronic data logger.

At which time is the ball travelling with the greatest velocity in an upwards direction

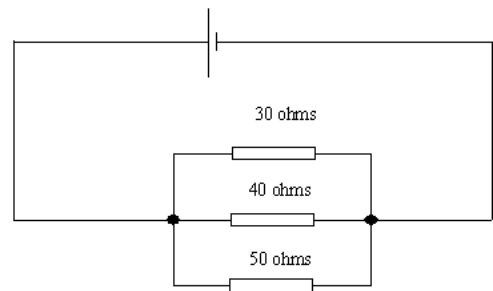


- (A) $t = 1 \text{ s}$
- (B) $t = 2 \text{ s}$
- (C) $t = 3 \text{ s}$
- (D) $t = 0.5 \text{ s}$

8. Identify which of the following SI units is equivalent to the watt.
- (A) J s
 - (B) J s⁻¹
 - (C) V A⁻¹
 - (D) J
9. Which of the following factors would result in a decrease in the resistance of a piece of copper wire
- (A) Increase the cross-sectional area
 - (B) Increase the temperature of the wire
 - (C) Increase the length of the wire
 - (D) Insulate the wire with plastic.
10. This question refers to the following circuit diagram. The voltage across the 50 ohm resistor is 100 volts.

The current through the 40 ohm resistor is closest to

- (A) 0.4 A
- (B) 0.5 A
- (C) 2.5 A
- (D) 2 A



***** End Part A *****

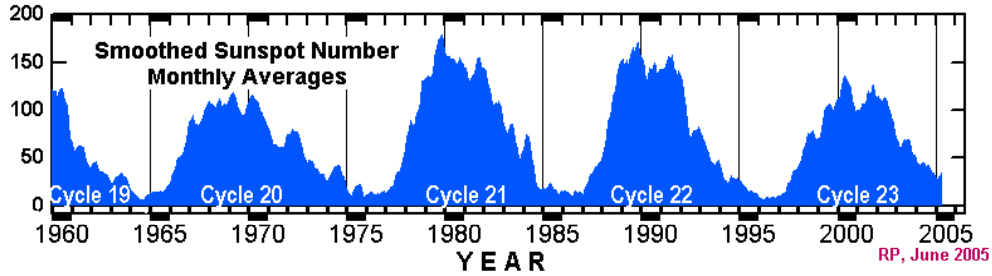
Part B

Total marks (60)

Attempt Questions 11 – 29

Answer Questions 11 – 29 on the answer sheet provided.

11. The following graph shows the monthly average number of sunspots.



(a) Use this graph to estimate the average length of the sunspot cycle. Show your working.

..... [/2]
.....
.....

(b) Predict the year of the next solar maximum (maximum sunspot activity)

..... [/1]

(c) Describe a sunspot.

..... [/2]
.....
.....

12. (a) Describe the nature and properties of the solar wind

..... [/2]
.....
.....
.....

(b) Assess two impacts of the solar wind on our society.

..... [/2]
.....
.....
.....

13. Explain the importance of wearing seatbelts in terms of Newton’s first law.

..... [/2]

14. A student conducts an investigation to investigate the relationship between the radius of circular motion of a car and the maximum speed at which the car can travel in the circular motion with losing traction (grip due to friction). The student drove the car around the each circular path several times increasing speed gradually until the car lost traction. The following results were collected.

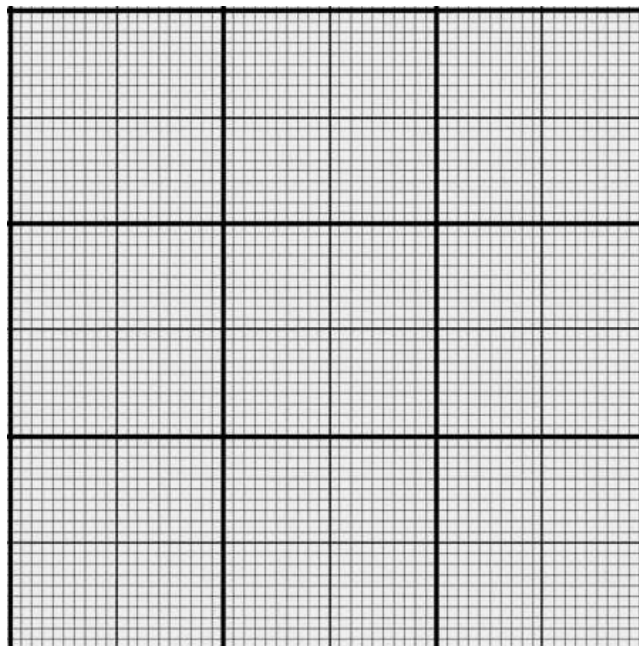
Radius (m)	10	15	20	25	30	35	40
Maximum Speed (km/hr)	6	14	25	38	57	75	102

(a) Identify the independent variable in this investigation.

..... [/1]

(b) Graph the above data, placing the radius on the horizontal axis.

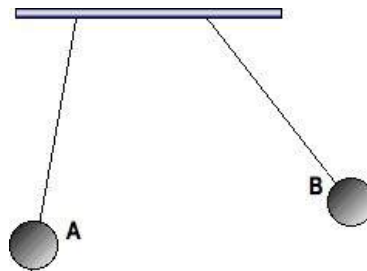
[/3]



(c) Describe in words the relationship between the graphed variables.

..... [/1]

15. The following diagram shows two charged plastic spheres supported by lightweight threads from an insulating support. Before the spheres were charged, the strings hung vertically. The spheres in the diagram are at equilibrium.



The charges exert equal and opposite forces on each other as a result of their charge. Compare the masses of A and B.

..... [/1]

16. A car travels south for 20 km and then travels east for a further 20 km. The entire journey takes 1 hour. Calculate the average velocity of the car.

..... [/2]

17. The current through a light globe used in a home (240 V power supply) was measured and found to be 0.25 A.

(a) Calculate the power of the light globe.

..... [/2]

(b) If the light globe is left on for 24 hours, calculate the electrical energy used by the light globe.

..... [/2]

(c) Identify the quantity having units of kilowatt hours (kW h).

..... [/1]

18. Identify two electrical safety devices used in the home and assess the importance of each device.

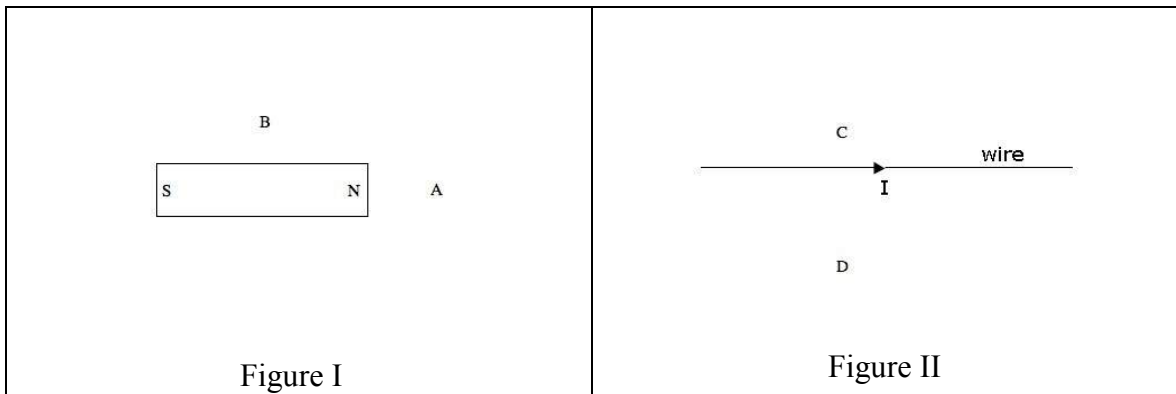
..... [/2]

19. (a) Identify on the diagram the direction of the magnetic field at A and B in figure I. [/1]

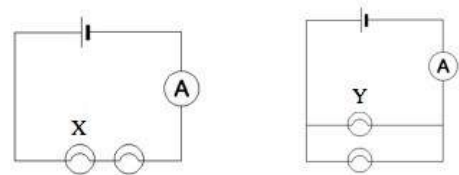
(b) Identify on the diagram the direction of the magnetic field at C in figure II. [/1]

(c) Compare the field at D with the field at C in figure II.

..... [/2]



20. This question refers to the adjacent series and parallel circuits containing identical globes, battery and an ammeter.



Compare

(a) the currents through light globes X and Y

(b) the power produced by light globes X and Y

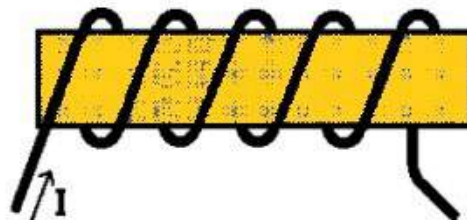
(a)..... [/1]

(b)..... [/1]

21. Calculate the energy used by a 240 V electric toaster having a resistance of 67 ohms during the two minutes it takes the toaster to toast some bread.

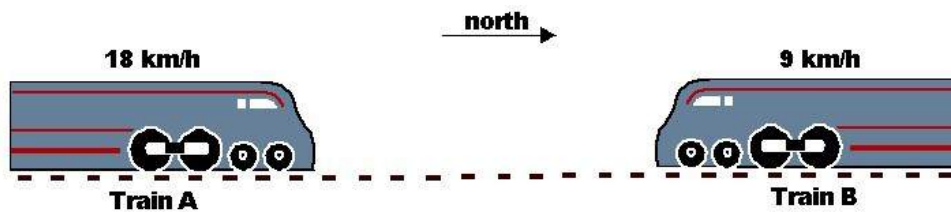
..... [/2]

22. A wire was wrapped around a cardboard tube as shown and a current was passed through the coil in the direction indicated.



Draw the magnetic field lines surrounding the coil and label the north pole. [/2]

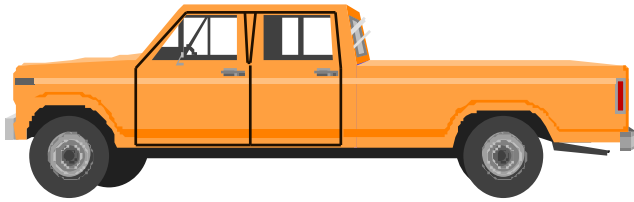
23. Two trains are heading towards each other on adjacent tracks.



State the apparent velocity of train A from the frame of reference of the driver of train B.

..... [/1]

24. This question refers to the diagram showing a 2000 kg truck moving at a constant speed of 60 km/h. The motor is applying an effective forward force of 3000 newtons on the vehicle.



- (a) State the frictional force acting on the vehicle and justify your answer.

..... [/2]
.....
.....

- (b) The truck then increased its speed to 80 km/h in a time of 20 seconds. Calculate the additional force acting on the vehicle if the frictional force does not change.

..... [/2]
.....
.....

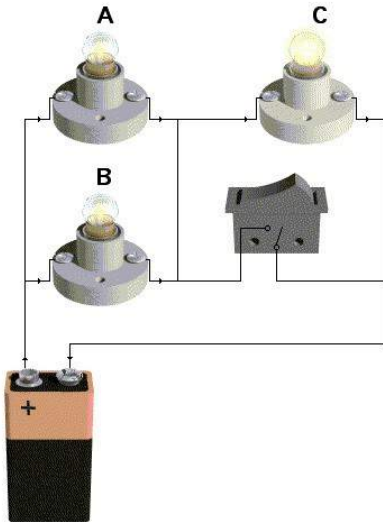
25. Outline the currently most accepted model of the origin of the Universe, identifying one piece of evidence supporting this model.

..... [/3]
.....
.....
.....
.....
.....
.....
.....

23. Calculate the current through a 20 ohm resistor across which the voltage is 10 mV.

..... [/2]
.....
.....

26. This question refers to the following diagram in which the lamps A, B and C are identical. In this diagram the switch is in the open position (i.e. No current flows through the switch)

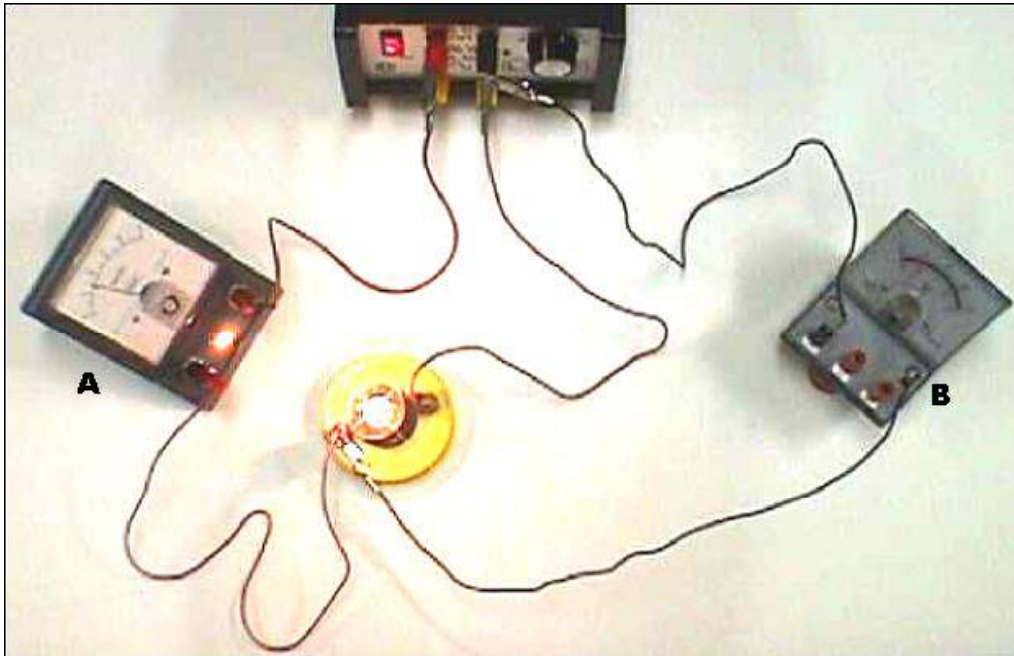


Draw a circuit diagram of the circuit in the space to the right of the circuit. [/2]

27. Draw the electric field lines that surround two charges shown in the following diagram if they both have a magnitude of 6 microcoulombs. [/2]



28. This question refers to the following photograph of an electrical circuit.



(a) Identify the meters A and B in the circuit.

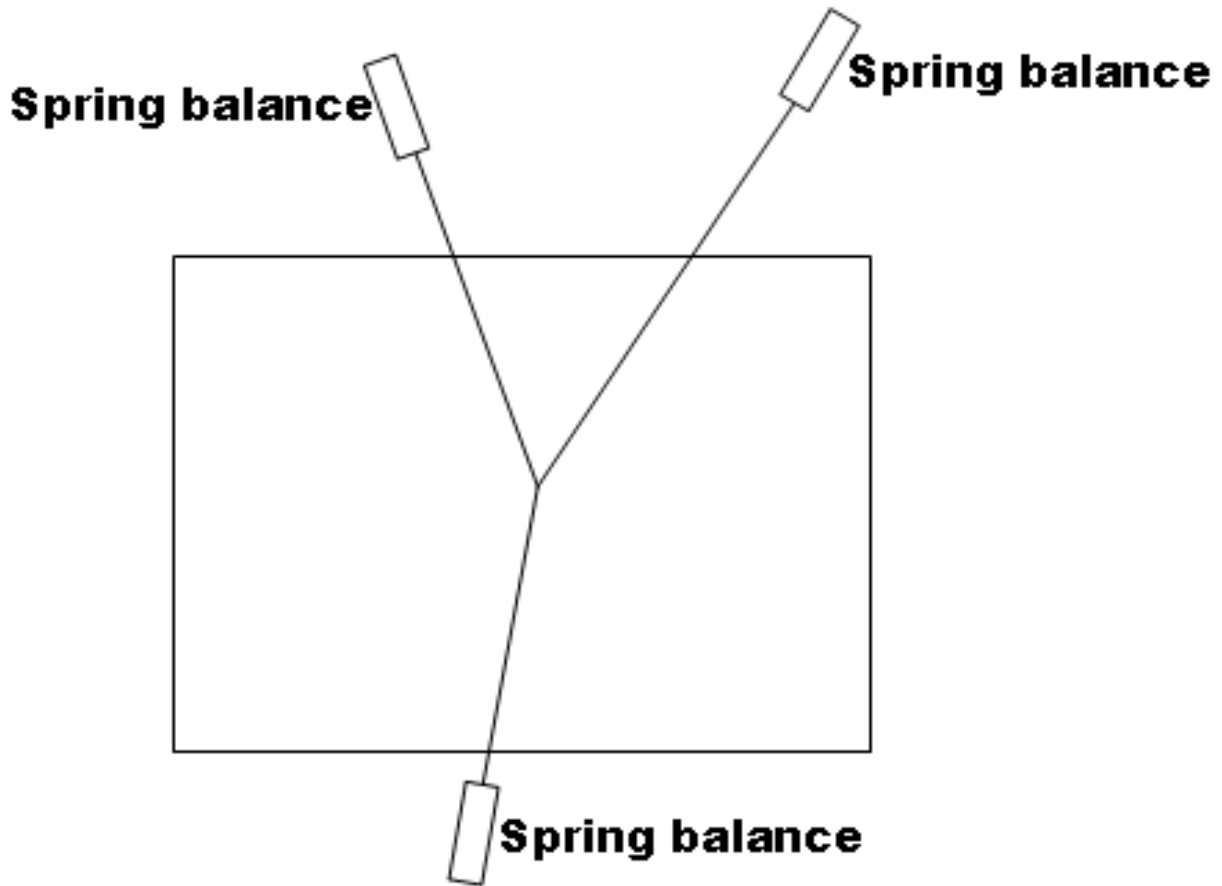
..... [/1]

(b) Sketch a graph representing the data that would be collected using this circuit and explain the shape of the graph. Place the variables on the axes that are conventionally used for each variable. [/1]



Paper continues on next page

29. You carried out a first-hand investigation using the string and spring balances set up as shown in the following diagram.



- (a) **Clarify** the aim of the investigation.

..... [/1]

- (b) **Propose** something that could happen during this investigation that would make the **measurements** of the tensions in the strings **invalid**.

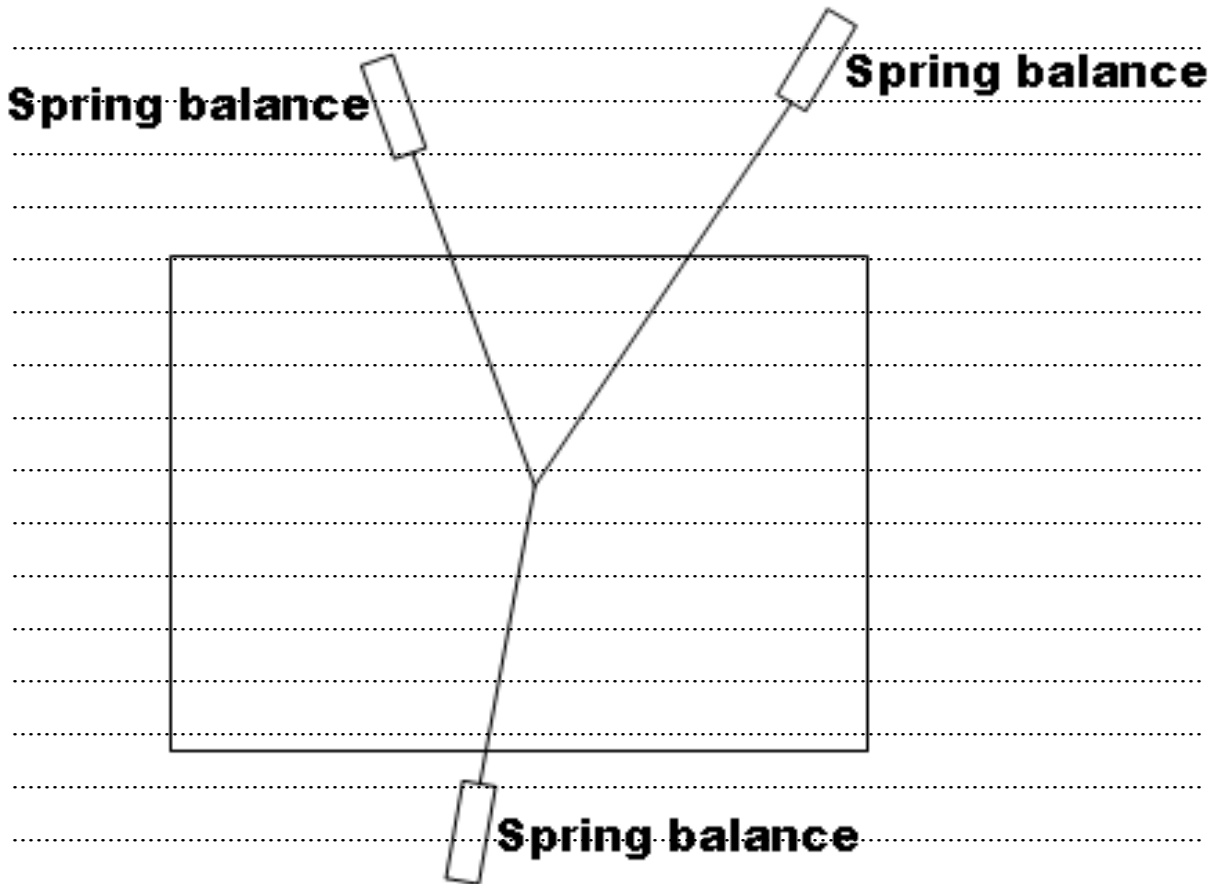
..... [/1]

- (c) **Assess** the following statement made by one student in his report on this investigation.
 “The independent variable that determines the tension in the strings is the length of each string.”

..... [/2]

- (d) One **group** carried out the investigation and the diagram above accurately shows the directions of the strings in the group's investigation. The group recorded the force on the spring balance at the bottom of the diagram as being 12 newtons.
 Determine the readings on the other two spring balances, stating any assumptions you made in doing so. (The diagram has been reproduced below for your convenience)

[/3]



- (e) Six **different** groups of students independently replicated the investigation using the same angles and same two forces on the upper spring balances and they measured the force on the lower one as being 11 N, 11 N, 12 N, 12 N, 12 N and 13 N.
 Comment on the reliability of this investigation. (1 mark)

[/1]

END

Answer Sheet

Part A

- | | | | | |
|-----|---------------------------|---------------------------|---------------------------|---------------------------|
| 1. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 2. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 3. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 4. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 5. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 6. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 7. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 8. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 9. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |
| 10. | (A) <input type="radio"/> | (B) <input type="radio"/> | (C) <input type="radio"/> | (D) <input type="radio"/> |

Marking Criteria

1. B	2. C	3. D	4. A	5. A	6. D*	7. A	8. B	9. C	10. C
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*Depending on how the question is interpreted 'B' is also valid.

Question 11a	
Criteria	Marks
Calculates average from 3 cycles over 32 years (from 1969 to 2001) and gives answer (11 years +/- 1)	2
Calculates the average based on less than 3 cycles OR shows correct working with incorrect answer OR has the correct answer but shows no working i.e. don't know if an average has been calculated	1

Question 11b	
Criteria	Marks
Predicts the next maximum (2012 +/- 2) – must be based on latest maximum (2001) and the answer to 11a	1

Question 11c	
Criteria	Marks
Describes two key features (magnetic disturbances on Sun's surface, lower temperature)	2
Describes one key feature	1

Question 12a	
Criteria	Marks
Describes the nature and main properties including identification of protons in the solar wind and the high velocity flow of these particles away from the Sun through the solar system	2
Identifies a component of the solar wind (without specifying / including protons) and mentions flow of these away from the Sun	1

Question 12b	
Criteria	Marks
Makes a judgement about the harm caused to at least two technologies (e.g. satellites, power grids) – it is NOT sufficient to simply list or state two effects caused by solar winds	2
Makes a judgement with reference to one effect or identifies two without making a judgement	1

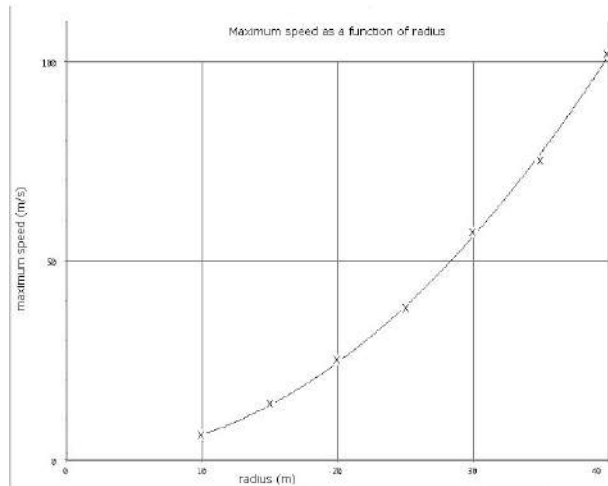
Solar wind causes geomagnetic storms when it brings material from the sun, leading to surges of electric current which can result in power failures in the Earth's power grids. Also, it-together with solar radiation-can damage satellites by interfering with their electrical parts or causing drag in their orbits so that they have a shorter orbit lifespan. Because of these things, solar wind is detrimental ~~and~~ to our society because it causes problems such as these. [2/2]

Solar winds can cause geomagnetic storms, storms where turbulence occurs in the magnetosphere between solar wind particles and the particles of the magnetosphere. This can cause power diodes and computers on satellites to fail and can also cause power grids on earth to fail. When this happens, many thousands of people in the affected area can lose power for several hours, before the grid is fixed. [2/2]

Question 13	
Criteria	Marks
Relates an effect (e.g. a person striking the windscreen/steering wheel) during a collision to the cause (the inertia – Newton's first law) which causes a person to maintain a constant velocity in a collision resulting in the person not stopping when the car decelerates rapidly in a collision.	2
Identifies inertia OR states Newton's first law	1

Question 14a	
Criteria	Marks
Identifies radius as the independent variable	1

Question 14b	
Criteria	Marks
Labels axes with quantities and units and chooses a suitable scale AND Plots points accurately using "X" AND Draws appropriate line of best fit using a pencil to plot points and draw line of best fit (may lose ½ marks)	3
Applies only two of the above criteria to drawing the graph	2
Applies only one of the above criteria to drawing the graph	1



Question 14c	
Criteria	Marks
States that the maximum speed increases at an increasing rate as the radius increases Or states that the maximum speed is proportional to the square of the radius	1

Question 15	
Criteria	Marks
Correctly deduces that the mass of A must be greater than the mass of B	1

Question 16	
Criteria	Marks
Substitutes correctly into equation for average velocity to obtain an answer of 28.3 km h ⁻¹ south-east (7.86 m s ⁻¹)	2
Uses the correct formula for average speed but does not substitute correctly OR omits direction (zero marks if both errors are present)	1

Question 17a	
Criteria	Marks
Obtains the correct answer with units by substitution into the equation $P = VI = 60 \text{ W}$	2
Answer is numerically correct OR shows correct units	1

Question 17b	
Criteria	Marks
Obtains the correct answer with units (lose mark for incorrect unit only if 17a has the correct unit i.e. mark not lost for wrong unit in 17a) by substitution into the equation $E = Pt = VIt = 5.184 \text{ MJ}$	2
Substitutes into the formula $E = VIt$ but does not convert hours to seconds (answer is thus 1440 J)	1

Question 17c	
Criteria	Marks

Identifies the quantity as energy	1
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Question 18	
Criteria	Marks
Identifies two devices (e.g. fuse, circuit breaker, insulation, switch) – ½ mark each AND Makes a judgment about the importance of each (e.g. fuses are important because they protect people from electric shock in the event of a short-circuit occurring in an electrical appliance by isolating high voltages) OR states clearly the role of each device	1
Identifies two devices (e.g. fuse, circuit breaker, insulation, switch) – ½ mark each AND States what they both do or makes a judgement about the importance of one device	1

Question 19a	
Criteria	Marks
Identifies the directions (A to right, B to left) – ½ mark each	1

Question 19b	
Criteria	Marks
Identifies the direction (out of the page)	1

Question 19c	
Criteria	Marks
States that the fields are in opposite directions (D is into page, C is out of page) AND States that the magnitude of the field at D is less than the magnitude of the field at C	2
Makes a correct comparison of either the direction or the magnitude of the field at points C and D	1

Question 20a	
Criteria	Marks
States that the current through X is less than the current through Y	1

Question 20b	
Criteria	Marks
States that the power produced by X is less than the power produced by Y	1

Question 21	
Criteria	Marks
Calculates the current through the toaster ($I=V/R=240/67=3.58$ A) AND Uses the current to calculate the energy ($E=VIt=240 \times 3.58 \times 120 = 103$ kJ)	2
Substitutes correctly into one equation relevant to the final answer ($I=V/R$ or $E=VIt$)	1

Question 22	
Criteria	Marks
Draws the correct pattern showing the direction of the lines (from the left-hand end to the right-hand end) with the north pole labelled (left-hand end)	2
Correct pattern without direction OR has field lines that touch/cross or are discontinuous (lose 1 mark) OR does not show correct polarity	1

Question 23	
Criteria	Marks
States the direction and the magnitude (27 km h ⁻¹ to the north) – lose ½ mark for either part incorrect	1

Question 24a	
Criteria	Marks
States that the frictional force is 3000 N since the velocity is constant and the net force must be zero [the frictional force opposes the forward force produced by the engine]	2
States that the frictional force is 3000 N but does not adequately justify the answer.	1

Question 24b	
Criteria	Marks
Calculates the acceleration ($a = v-u / t = (22.2-16.7) / 20 = 0.28 \text{ m s}^{-2}$) AND Calculates the net force ($F=ma=2000 \times 0.28=556 \text{ N}$) OR Writes the correct answer with units without working being shown	2
Uses both equations but substitutes incorrectly into one equation. (eg in km/hr instead of m/s)	1

Question 25	
Criteria	Marks
Answer adequately outlines the major features of the big bang and identifies one piece of evidence supporting the theory such as the red shift of receding galaxies or cosmic background radiation	3
Answer identifies the big bang theory and identifies relevant evidence supporting it.	2
Answer identifies the big bang theory or Identifies the evidence supporting it.	1

Question 23	
Criteria	Marks
Calculates the current as being $5 \times 10^{-4} \text{ A}$ using $I = V/R = 0.010 / 20$	2
Calculates a current value using the correct equation but fails to convert mV to volts	1

Question 26	
Criteria	Marks
Draws a conventional circuit diagram (“squared up”) showing two lamps in parallel with each other and this combination being in series with a third lamp across which an open switch is wired (which would short-circuit the lamp it is across if the switch were closed).	2
Uses the correct symbols for all the components (battery, 3 lamps, switch) but does not draw a correct circuit OR has the correct circuit but one or more symbols are incorrect	1

Question 27	
Criteria	Marks
Draws the correct field pattern for equal / opposite charges with arrows representing the field direction going from positive to negative charge.	2

Draws the correct field pattern for equal / opposite charges but has arrows missing, lines broken and/or crossing/touching	1
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Question 28 a)	
Criteria	Marks
Correctly identifies A as an ammeter and B as a voltmeter	1

Question 28 b)	
Criteria	Marks
Sketches a graph with voltage and current labelled clearly on the axes AND line of best fit is a curve (a light globe is a non-ohmic conductor).	1
Sketches a graph with voltage and current labelled clearly on the axes BUT line of best fit is a straight line.	1/2

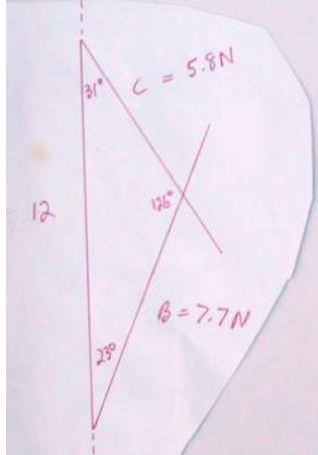
Question 29 a)	
Criteria	Marks
Describes a reasonable aim (eg investigate the effect of 3 forces acting on a single point)	1

Question 29 b)	
Criteria	Marks
Identifies a significant and specific experimental factor that would invalidate the measurements (eg string pulled over the edge of the table etc)	1

Question 29 c)	
Criteria	Marks
Identifies that the string length has no effect on the string tension and makes a clear judgement that this makes the statement incorrect,	2
Identifies that the string length has no effect on the string tension but does not make a clear judgement that this makes the statement incorrect.	1

Question 29 (d)	
Criteria	Marks
Answer correctly uses a scale vector diagram(or a vector diagram and trigonometry) to calculate the two forces and states that the assumption made is that the three force vectors form a closed triangle as the net force is equal to zero.	3
Answer uses a vector diagram and makes the correct assumption but does not accurately calculate the magnitude of the vectors.	2
Answer uses a vector diagram but does not state the assumption or Answer makes the correct assumption but does not draw the vector diagram correctly.	1

Scale Diagram (1cm = 1N)



Trigonometry

$$\frac{B}{\sin 31} = \frac{12}{\sin 126}$$

$$B = 12 \sin 31 / \sin 126 = 7.64 N$$

$$C = 12 \sin 23 / \sin 126 = 5.8 N$$