

2007

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 Pitt

All sections of this paper must be handed in separately.

Name _____

Teacher 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 – 30
- 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
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Total marks (10)**Attempt Questions 1 – 10****Allow about 20 minutes for this part**

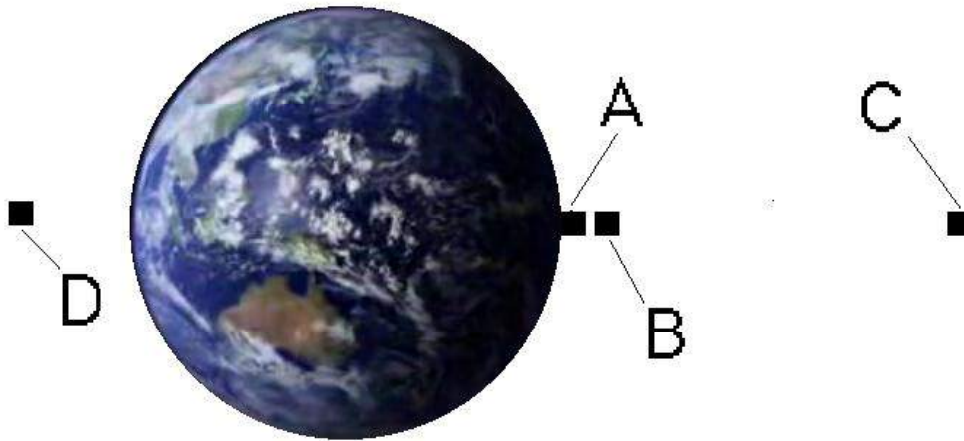
1. This is the symbol for the nucleus of an atom.



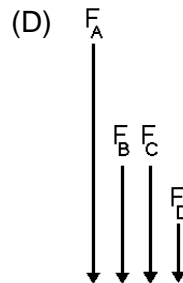
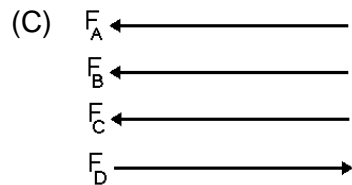
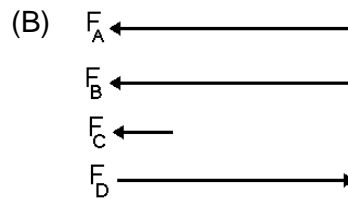
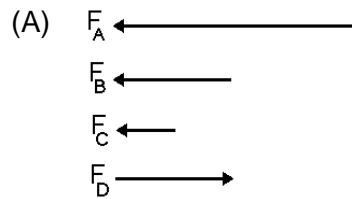
Which statement correctly describes this nucleus?

- (A) The nucleus is technetium and it has 98 neutrons.
(B) The nucleus is californium and it has 98 nucleons.
(C) The nucleus is technetium and it has 55 neutrons.
(D) The nucleus is caesium and it has 55 protons.
2. Which of the following best describes an alpha particle?
- (A) An electron ejected from a radioactive nucleus
(B) A particle consisting of two protons and two neutrons
(C) A radioactive particle consisting of four nucleons
(D) An energetic form of electromagnetic radiation

3. The following diagram shows the locations of a 1 kg mass, A, on the Earth's surface, and three other identical masses, B-D. The distances of the masses from Earth are drawn to scale.



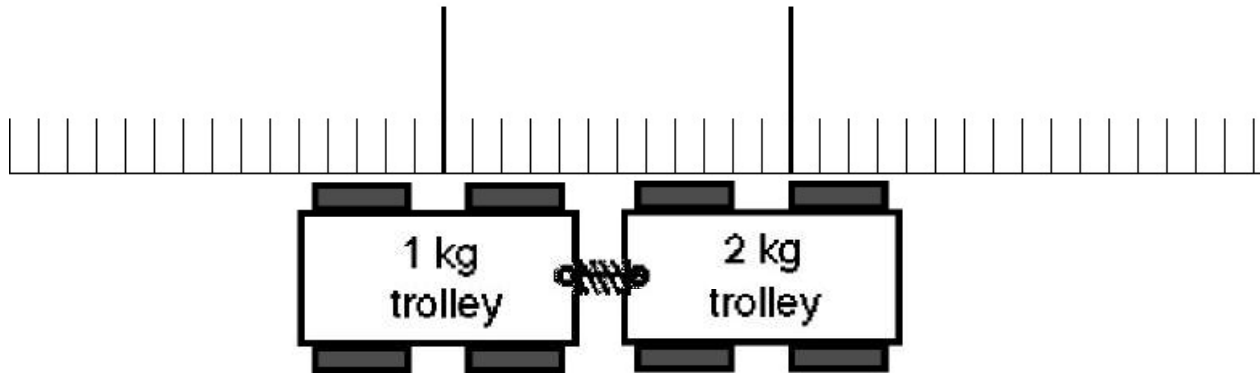
Which of the following best represents the forces acting on the masses A-D respectively?



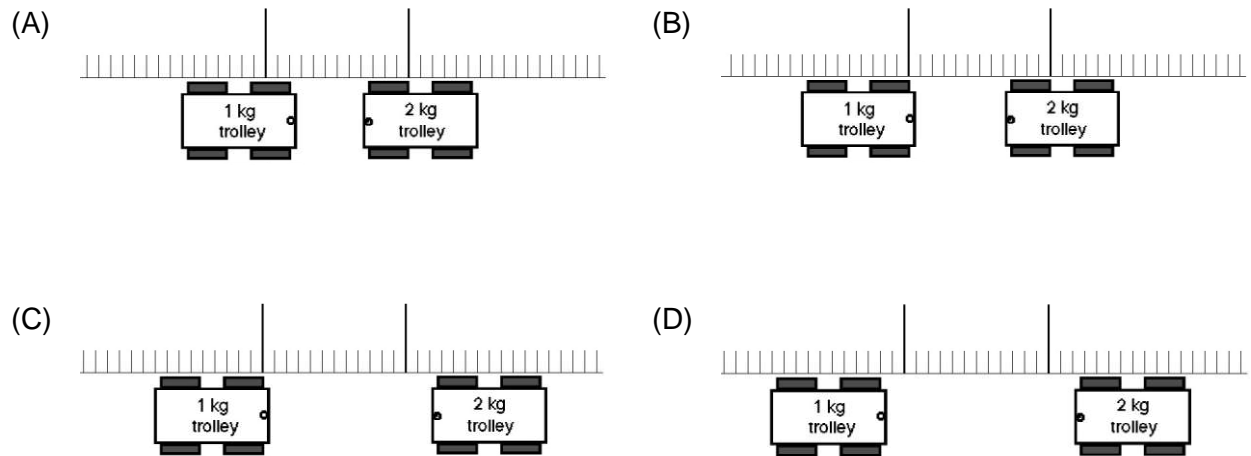
4. The speed of sound in air at 21°C is 344 m s⁻¹. Which of the following best states the wavelength in air of a sound wave having a frequency of 512 Hz?

- (A) 0.7 m
- (B) 1.5 m
- (C) 7 m
- (D) 15 m

5. The following diagram shows two trolleys held in place by a string tying them together. Marks on the floor show the initial positions of the trolleys. A spring compressed between the trolleys will push them apart when the string is cut. The masses of the trolleys are 1 kg and 2 kg.

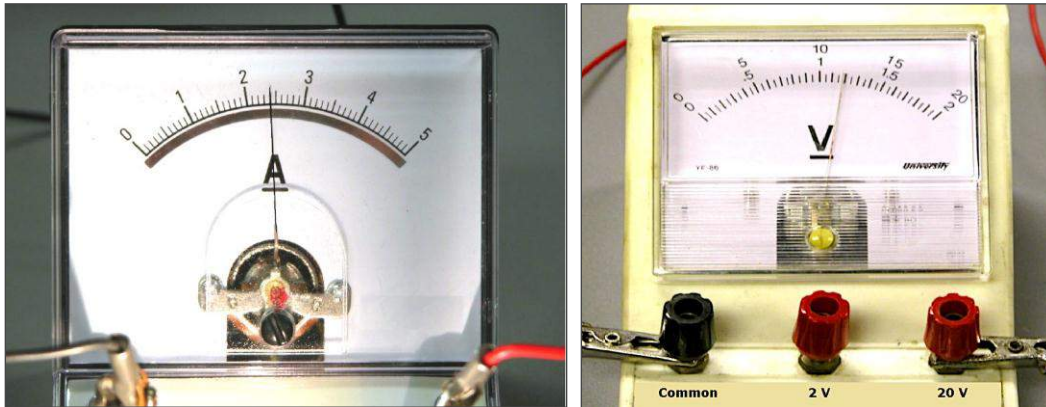


Which of the following shows the positions of the trolleys after the string has been cut?



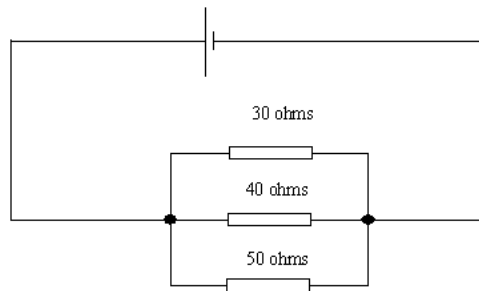
6. The light intensity from two identical stars, A and B, is measured from the Earth. Light from the star A is measured to have $\frac{1}{9}$ the intensity as coming from star B. The star A is three million light years from Earth. How far from Earth is the star B?
- (A) 1 million light years
 - (B) 27 million light years
 - (C) 333 000 light years
 - (D) 9 million light years

7. The following photographs show two meters correctly connected in a circuit consisting of a voltage source and a single lamp.



Measured in ohms, what is the resistance of the lamp?

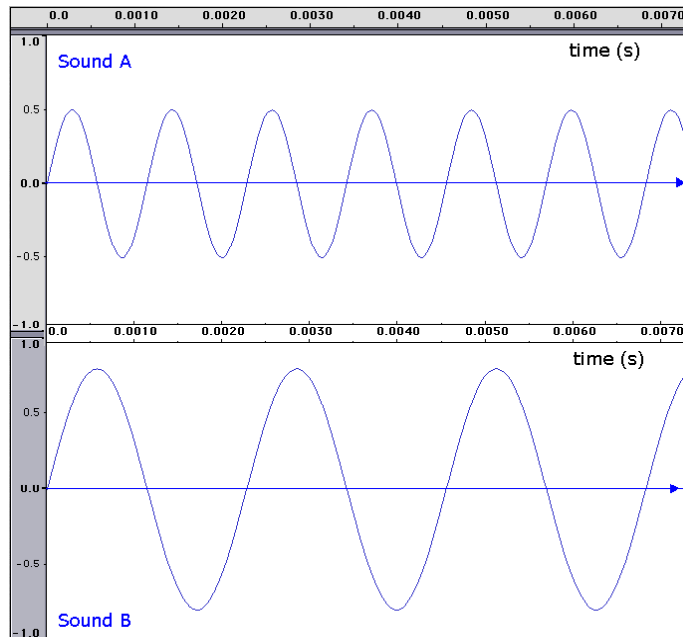
- (A) 2.4
 - (B) 1.2
 - (C) 28.8
 - (D) 5
8. This question refers to the following circuit diagram. The voltage across the 30 ohm resistor is 100 volts.



The current through the 50 ohm resistor is closest to

- (A) 0.4 A
 - (B) 0.5 A
 - (C) 2.5 A
 - (D) 2 A
9. “The change in potential energy per unit charge moving from one point to the other”. This statement defines which of the following quantities?
- (A) Potential difference
 - (B) Power
 - (C) Current
 - (D) Resistance

10. The graphs below represent audacity traces of two sound waves



Compared to sound A, sound B is

- (A) louder and has a higher pitch
- (B) softer and has a higher pitch
- (C) softer and has a lower pitch
- (D) louder and has a lower pitch

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

Part B

Total marks (60)

Attempt Questions 11 – 30

Answer Questions 11 – 30 in the spaces on the sheet provided.

11. An ant travelled 20 m in half an hour. Calculate, in m s^{-1} , the average speed of the ant, 2M

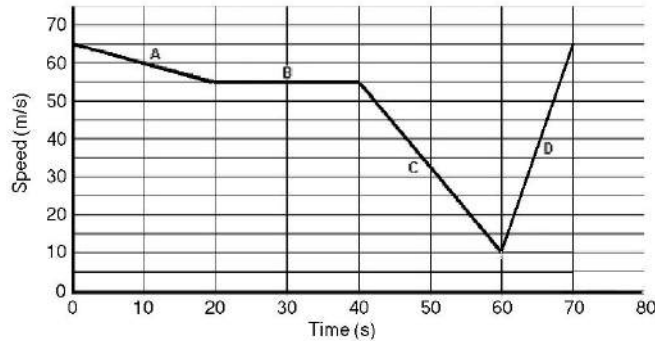
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12. This question refers to the following graph showing information about the motion of an object travelling in straight line.



- (a) Describe the motion of the object during the time interval B, from 20 to 40 seconds. 1M

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- (b) Compare the motion of the object during time intervals A and D. 2M

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- (c) Calculate the distance travelled by the object during time interval D, from 60 to 70 seconds. 2M

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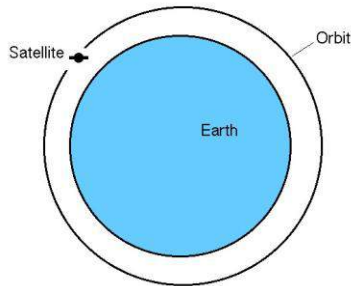
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13. The average speed of a car travelling from Lake Macquarie to Sydney, a distance of 130 km, was 88 km h^{-1} . The journey consisted of 100 km of freeway plus a 30 km drive through the city, which included some 40 sets of traffic lights. Describe **two** significant features of the journey in terms of the car's velocity. 2M

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14. This question refers to the following diagram showing a satellite orbiting the Earth in a circular orbit at a constant speed.



Assess the statement made by a student “The satellite is in space and no net force is acting on it because its speed is constant”.

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15. The acceleration due to gravity on the Moon is 1.6 m s^{-2} . Calculate the speed of a feather falling for 5 seconds from rest.

2M

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16. A rocket of mass 1000 kg is being launched upward by engines that produce an upward force 20000 N.



(a) Calculate the force of gravity on the rocket, stating both the direction and the magnitude of the force.

2M

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(b) Calculate the net force acting on the rocket.

1M

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(c) Calculate the acceleration of the rocket.

2M

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17. Describe the horizontal forces acting on a car travelling along a level road at a constant velocity of 60 km/hr.

3M



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18. About 100 CE, Ptolemy developed a sophisticated geocentric model of the solar system. In the 16th century, Nicholas Copernicus proposed a heliocentric model.

(a) Describe a feature common to Ptolemy's and Copernicus' models.

1M

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(b) Outline two processes that lead to a scientific model being accepted.

2M

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19. The engines of a rocket taking off produced a constant force. It was observed that this produced an acceleration, which increased as the rocket gained altitude. Propose a reason why this happened.

2M

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20. A person was sitting in a car that accelerated at 5 m s^{-2} . This is a high acceleration for a car.

(a) Describe the physical sensation the person would experience due to this acceleration.

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(b) Account for this sensation in terms of Newton's first and second laws.

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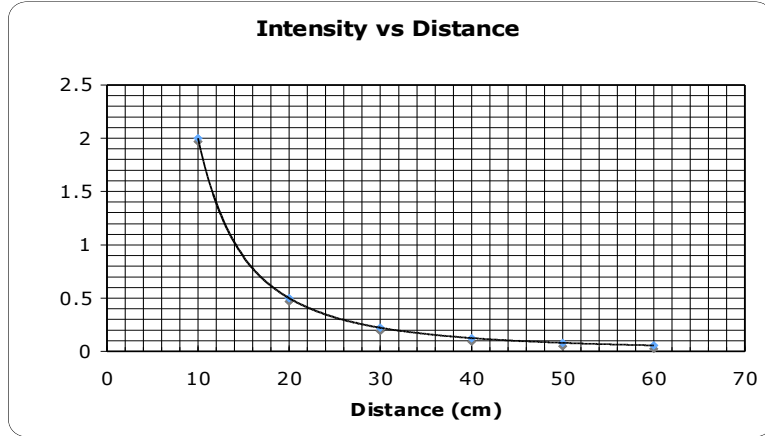
21. Outline how Isaac Newton, in proposing the law of gravity, changed the way we think about the motion of the planets and motion of objects near the Earth's surface.

2M

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22. A group of students measured the intensity of a light globe at distance intervals of 10 cm from the globe. The table presents the values obtained by the group. The same data is graphed below the table.

Distance (cm)	10.00	20.00	30.00	40.00	50.00	60.00
Intensity (arbitrary units)	2.00	0.50	0.22	0.13	0.08	0.06



One student in the group proposed that the intensity of the light was inversely proportional to the distance from the source.

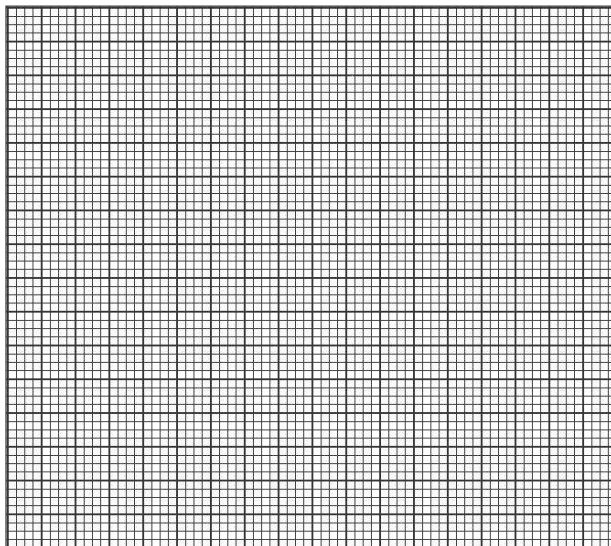
- (a) Complete the table below with the data he would have calculated to test this model.

1M

Distance (cm)	10.00	20.00	30.00	40.00	50.00	60.00
Intensity (arbitrary units)	2.00	0.50	0.22	0.13	0.08	0.06

- (b) Plot this data on the axes below and draw the line of best fit for the data.

3M



- (c) What conclusion should the student draw from this graph, given his proposal? Justify your response. (2M)

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23. Write a procedure to be followed, using a ray box kit, which would allow data to be measured that would allow the refractive index of a glass prism to be determined.

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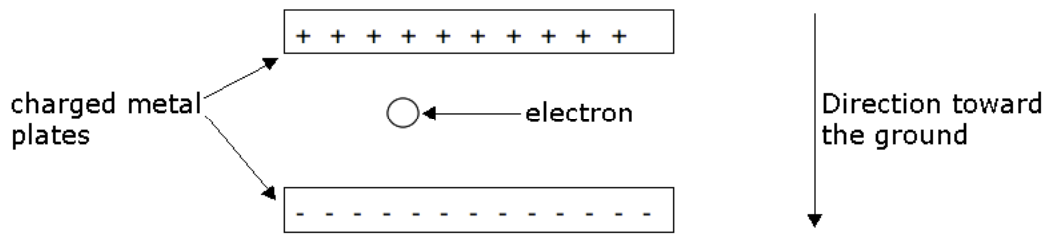
24. A ray of light travelling in air struck the surface of a glass prism with an angle of incidence of 40° . The angle of refraction in the glass was 30° .

Predict the angle of refraction of light entering the same prism with an angle of incidence of 20° .

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25. Shown below is an electron located between two charged plates producing a uniform electric field. The force of gravity also acts on the electron.



Calculate the electric field strength required to make the electron hover (not fall to towards the ground)

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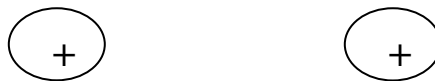
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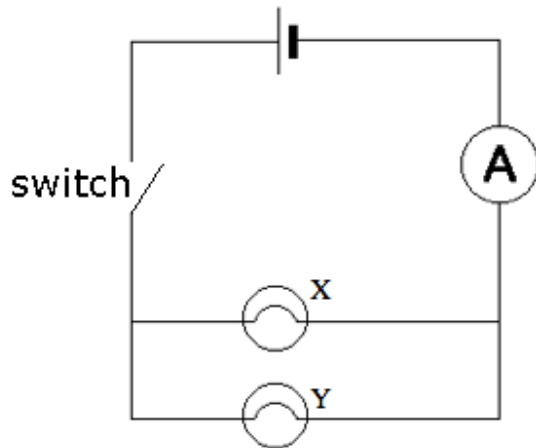
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26. Sketch the electric field surrounding two equal positive charges shown below.

2M



27. The following circuit shows two globes connected in parallel connected to a battery.



- (a) The globe X has three times the resistance of the globe Y.
Compare the current through and voltage across globes X and Y.

2M

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- (b) A student used an ammeter connected to a data logger to investigate the current in this circuit after closing the switch. The student observed that the current decreased from its initial value in the first few milliseconds after the switch was closed.
Explain the likely cause of this.

1M

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28. (a) Define electric current.

1M

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- (b) Propose two reasons why a single series circuit would not be suitable to operate the lights in two rooms of a house.

2M

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29. Use crosses and dots to represent the **direction** and **magnitude** of the magnetic field surrounding the current carrying conductor shown below.

2M



30. Explain one application of magnetism in a household appliance or device

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END

Answer Sheet

Part A

1. (A) (B) (C) (D)
 2. (A) (B) (C) (D)
 3. (A) (B) (C) (D)
 4. (A) (B) (C) (D)
 5. (A) (B) (C) (D)
 6. (A) (B) (C) (D)
 7. (A) (B) (C) (D)
 8. (A) (B) (C) (D)
 9. (A) (B) (C) (D)
 10. (A) (B) (C) (D)
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Examiners' use only

Total Multiple choice _____/10

Part B _____/60

Total for paper _____/70

Marking Criteria

Multiple Choice

1. C 2. B 3. A 4. A 5. B 6. A 7. D 8. D 9. A 10. D

Q 11	Criteria	Mark
Correct answer (0.011 m s ⁻¹)		2
Correct substitution into $v = \frac{\Delta r}{\Delta t}$ (not necessarily SI)		1

Q 12a	Criteria	Mark
States that the speed is constant at 55 m s ⁻¹		1

Q 12b	Criteria	Mark
Identifies that for interval A the object is slowing down at 0.5 m s ⁻¹ and over interval D the object is speeding up at 5.5 m s ⁻¹ AND makes an explicit comparison.		2
Identifies that for interval A the object is slowing down and over interval D the object is increasing speed BUT does not make an explicit comparison.		1

Q 12c	Criteria	Mark
Calculates the average speed ($v_{av} = \frac{u + v}{2} = 37.5 \text{ m s}^{-1}$) and uses this to calculate the distance (375 m) Or correctly calculates the area under the graph.		2
Uses a valid method (eg area under graph) but makes an error in calculations.		1

Q 13	Criteria	Mark
Two significant factors relating to the cars velocity (not acceleration or force etc)		2
One significant factor relating to velocity		1

Q 14	Criteria	Mark
A judgement that the statement is incorrect and correct reasoning relating the change in direction requiring a net force.		2
Some correct reasoning about net force.		1

Q 15	Criteria	Mark
Correct answer of 8ms ⁻¹		2
Uses correct formula $v=u+at$ but incorrect substitution.		1

Q 16a	Criteria	Mark
Calculates and states the force (9800 N downward)		2
Substitutes into $F = mg$ correctly OR states the direction of the force of gravity		1

Q 16b	Criteria	Mark
Calculates the correct net force (10 200 N upward) Not necessary to state the direction.		1

Q 16c	Criteria	Mark
Calculates the acceleration (10.2 m s ⁻² upward) If the direction was shown in part (b), but not in part (c) this is acceptable in this question (may not be the usual way in which marks are allocated – so always put direction explicitly)		2
Substitutes correctly (incorrect net force from b. is ok) into $F = ma$ to calculate the acceleration (10.2 m s ⁻² upward) but does not state direction OR States the direction of the acceleration consistent with other explicit information in the question.		1

Q 17	Criteria	Mark
Answer includes the force of the tyres on the road which pushes the car forwards and frictional forces acting in the opposite direction.		3
Answer states that these forces are equal in magnitude and opposite in direction.		2
Correct forces but no comment on magnitude or incorrect description of one force.		1
One forces correctly described.		1

Q 18a	Criteria	Mark
Both describe the motion of planets in circular orbits.		1

Q 18b	Criteria	Mark
Any two of the following A model must be able to explain phenomena. A model must be backed up by scientific evidence. A model must be able to make predictions.		2
One of the above points		1

Q 19	Criteria	Mark
Correct reasoning relating to a factor that increases acceleration eg decrease in mass when fuel is burnt.		2
Identifies a factor but with little or no reasoning.		1

Q 20a	Criteria	Mark
Indicates clearly in the answer that the person would feel as if he/she was being pushed backward into the seat.		1

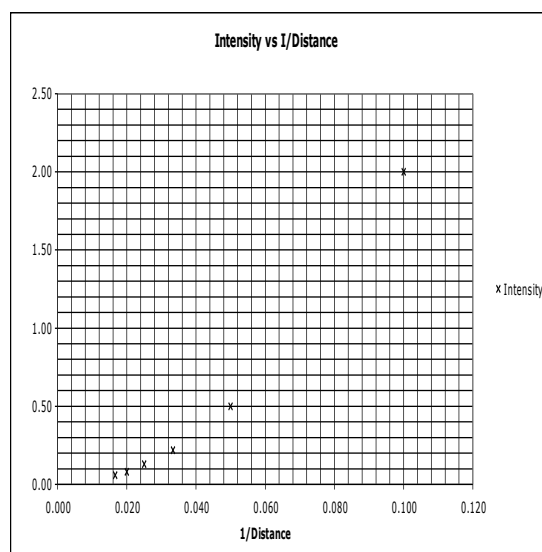
Marking Criteria

Q 20b	Criteria	Mark
	Demonstrates an understanding of Newton's first and second laws by relating an aspect of what the person feels to each of the laws. e.g. the person is pushed back into the seat because of his/her inertia (first law) AND the person is accelerated forward with the car because the seat applies a net forward force on the person (second law), which is the force the person feels. (Some answers received 1½ marks where both laws were stated AND a correct link was made about what the person felt to one law)	2
	States Newton's first and second laws OR Correctly relates what the person feels to either the first or second law.	1

Q 21	Criteria	Mark
	Shows a clear understanding of the change in thinking by stating that before Newton, it was assumed that different laws governed celestial motion to those that governed motion on Earth but AFTER Newton, the same law of gravity could be used to account for both types of motion.	2
		1

Q 22a	Criteria	Mark
	Completes the table with correct values of 1/d	1

Distance (cm)	10	20	30	40	50	60
Intensity	2.00	0.50	0.22	0.13	0.08	0.06
1/distance (cm ⁻¹)	0.100	0.050	0.033	0.025	0.020	0.017



Q 22b	Criteria	Mark
	Graph must include accurately plotted points, scales correct and quantities labelled on both axes and line of best fit	3
	Must include line of best fit and omits one of the above	2
	Draws the line of best fit	1

Q 22c	Criteria	Mark
	Concludes (from the correct graph) that the proposal (hypothesis) is NOT supported and provides a reason (i.e. that the graph of intensity vs 1/distance is not linear and therefore the relationship is not one of inverse proportionality)	2
	Presents a justification consistent with the graph (if the graph is not correct)	1

Q 23	Criteria	Mark
	Lists a sequence of instructions that would result in measurements of the angles of incidence and refraction for a ray of light entering a prism. The steps would include at least: (1) Use a ray box to pass a narrow beam of light through a rectangular prism placed on a plain sheet of paper, [with the ray striking the surface at an angle to the normal]. (2) Mark the position of the block by tracing around its edges (3) Use two marks to record the path of the incident ray and the ray emerging from the other side of the prism (4) Remove the prism and draw in the paths of the incident ray and the ray emerging from the prism. (5) Join the points where the ray enters and leaves the prism (6) draw in the normal to the prism surface at the point where the ray entered the prism (7) measure and record the angle between the incident ray and the normal – the angle of incidence, and the angle between the refracted ray's path and the normal inside the prism – the angle of refraction (8) repeat the above steps to record data for at least six angles of incidence over as wide a range as possible [better answers made use of a diagram to clarify the procedure]	4
	The procedure must be written as instructions (imperative tense) NOT in the past tense (which is used when reporting.	
	Must use imperative tense and mention repetition BUT provides an outline not including all steps, but which at least shows an understanding of how the path of the ray THROUGH the prism is recorded for measurement.	3
	Describes a procedure that is in principle correct, but omits steps necessary to make the procedure clear to a person who had not previously carried out the task.	2
	Identifies at least one significant aspect of the appropriate use of the apparatus in the investigation.	1

Q 24	Criteria	Mark
	Calculates using Snell's law the correct angle of refraction (15.4 degrees or 15 degrees 26 minutes) NB a coincidentally nearly-correct answer using angle ratios gets zero marks.	3
	Calculates the refractive index of the prism. (1.29) and substitutes into $n = \sin(i)/\sin(r)$ but does not correctly calculate the final answer.	2
	Calculates the refractive index of the prism. (1.29)	1

Marking Criteria

Q 25	Criteria	Mark
	Calculates the correct gravitational force (8.93×10^{-30} N) and clearly equates this to the force acting on the electron due to the electric field. The magnitude of the field is then correctly calculated using $F = qE$	3
	Calculates the correct gravitational force and equates this to the force acting on the electron due to the electric field. The magnitude of the field is then incorrectly calculated using $F = qE$ OR Uses an incorrectly calculated value of the gravitational force to calculate E using the correct method	2
	Calculates the correct gravitational force	1

Q 26	Criteria	Mark
	Correct field pattern showing direction and magnitude (from spacing) – lines must not touch, cross or be broken	2
	Correct field pattern with one or more errors	1

Q 27a	Criteria	Mark
	Correctly states that the potential difference is the same across each globe and that the current through Y is three times greater than the current through X	2
	Correctly states that the potential difference is the same across each globe and that the current through Y is greater than the current through X	1.5
	Correct comparison regarding voltage OR current.	1

Q 27b	Criteria	Mark
	Response clearly links increased resistance with the heating effect of the current.	1

Q 28a	Criteria	Mark
	Defines current as the rate of flow of charge	1
	Defines current as the flow or movement of charges	0.5

Q 28b	Criteria	Mark
	Clearly outlines TWO relevant reasons (eg turning off the switch will turn off lights in both rooms, lights in each room will be dimmer since the voltage is split between each globe)	2
	Clearly outlines ONE relevant reason	1

Q 29	Criteria	Mark
	Diagram shows the correct direction of the magnetic field (out of page above wire) using appropriate symbols and uses spacing to clearly show the field weakening as the distance from the wire increases	2
	Diagram shows the correct direction of the magnetic field using appropriate symbols	1

Q 30	Criteria	Mark
	Response identifies a relevant household appliance and thoroughly explains the role of magnetism in the functioning of the device	3
	Response identifies a relevant household appliance and establishes some link between magnetism and the functioning of the device.	2
	Response identifies a relevant household appliance	1