

P 11 Y

BAULKHAM HILLS HIGH SCHOOL

YEARLY EXAMINATION

2009

YEAR 11
PHYSICS

GENERAL INSTRUCTIONS

- Reading time - 5 minutes
- Working time - 2 hours
- Write, using black or blue pens
- Draw diagrams using pencil
- Board approved calculators may be used
- A Data and Formula Sheet is provided with this paper

TOTAL MARKS - 72

Section I - 15 marks

- Attempt Questions 1-15
- Allow about 25 minutes for this section

Section II - 57 marks

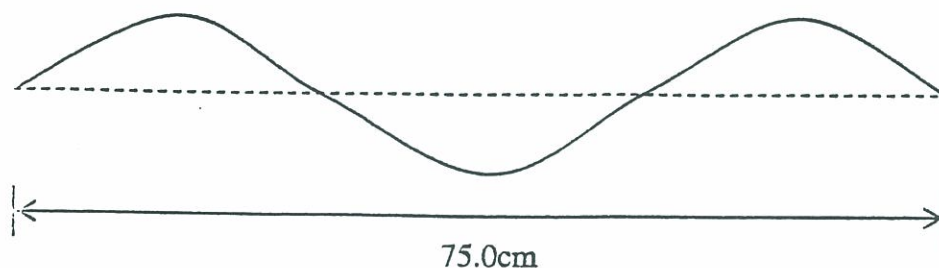
- Attempt Questions 16-32
- Allow about 95 minutes for each part
- You must show all working

Section I - Multiple Choice

15 marks

Select the most correct response, A, B, C or D and mark your answer on the Multiple Choice Answer Sheet provided.

1. A wave travelling in a guitar string was photographed. The results are presented in the diagram below.



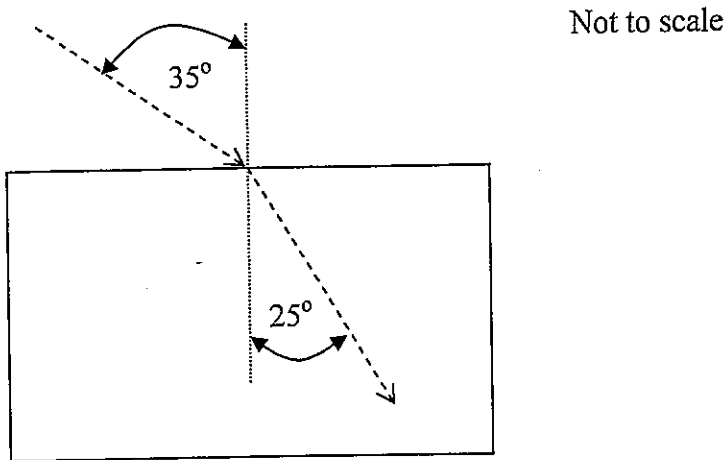
The frequency of the note produced by the guitar string was 540 Hz. The velocity of the wave in the guitar string was

- a) 135 ms^{-1}
b) 202.5 ms^{-1}
c) 270 ms^{-1}
d) 405 ms^{-1}
2. Which one of the following is NOT relevant in helping data transmission in optical fibre for telephone communication?
- a) the electromagnetic waves are totally internally reflected due to the high refractive index of the core of the optical fibre
b) the optical fibres are in coherent bundles so that the image received is identical to that which is taken
c) the information is encoded digitally rather than in analogue format
d) amplifiers are used every 25 km of fibre cable so that the signal does not decay according to the inverse square law
3. A soundwave is observed to change its speed, direction of travel and wavelength but not its frequency.

What can be concluded from this?

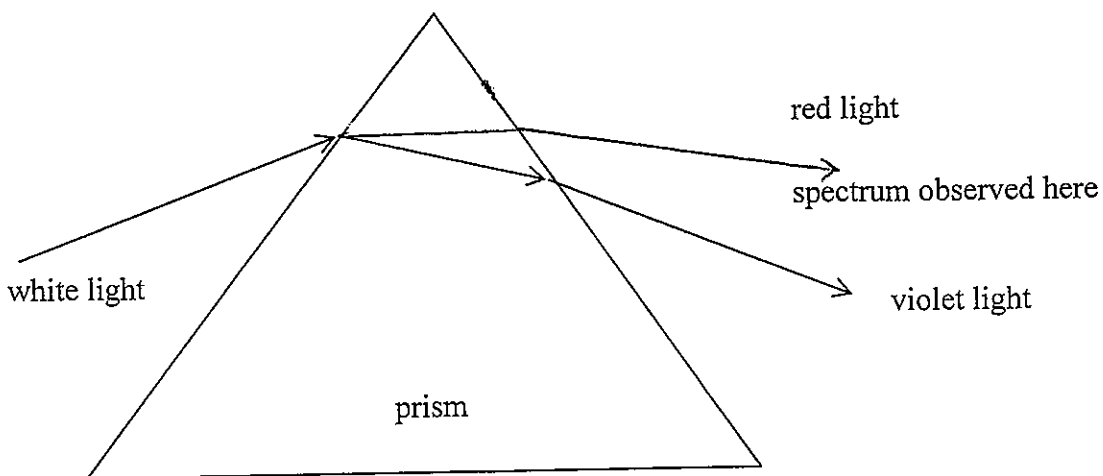
- a) The wave has been reflected
b) The wave has been refracted
c) The wave has been diffracted
d) The wave has been superimposed on another wave

4. A light ray in air enters a clear prism and refracts as shown.



The speed of the light inside the prism is closest to

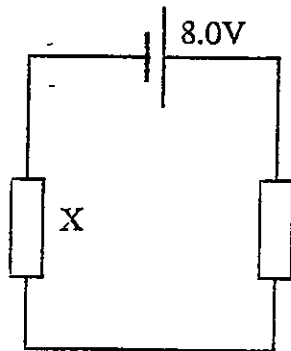
- a) $2.14 \times 10^8 \text{ms}^{-1}$
 - b) $2.21 \times 10^8 \text{ms}^{-1}$
 - c) $4.07 \times 10^8 \text{ms}^{-1}$
 - d) $4.20 \times 10^8 \text{ms}^{-1}$
5. When white light passes through a glass prism, a spectrum is formed (as shown below). Which of the following statements best explains why this happens?



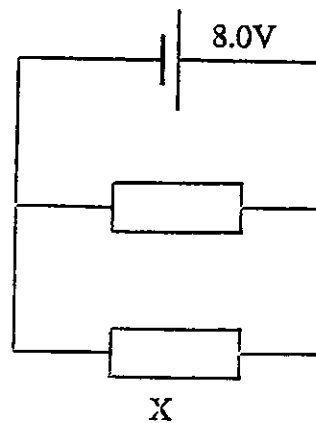
- a) The distance the light travels through the prism varies
- b) The light at the blue end of the spectrum travels faster than light at the red end
- c) Lower frequencies of light are refracted more than higher frequencies
- d) Shorter wavelength light travels slower through the glass than longer wavelength light

6. Several circuits were constructed using identical 4.0 ohm resistors
 In which circuit has the resistor labelled 'x' the most current flowing through it?

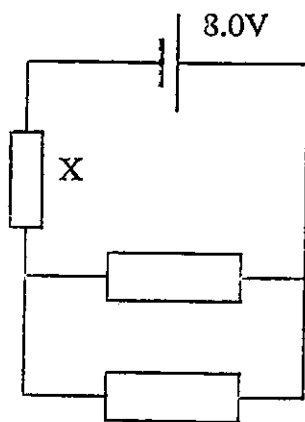
(A)



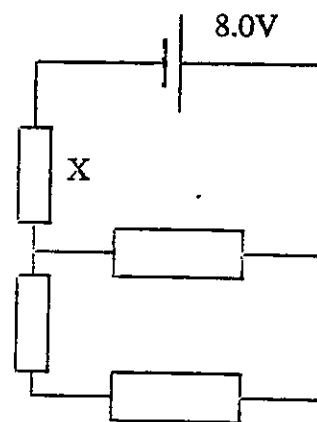
(B)



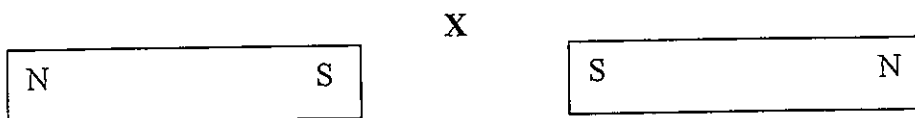
(C)



(D)



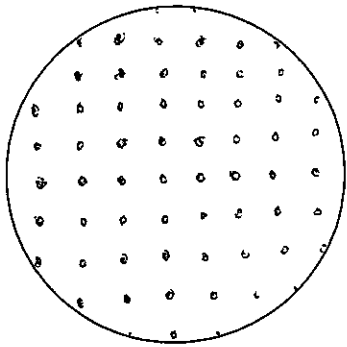
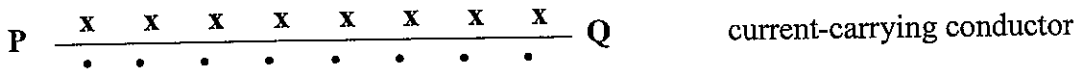
7. Two bar magnets were arranged as shown below.



When the north pole of a third bar magnet was placed at point (X), the force experienced was in which direction?

- a) up the page
- b) down the page
- c) to the right
- d) to the left

8. The diagrams below show the magnetic field around a straight current-carrying conductor PQ and inside a current-carrying coil.



Which choice correctly identifies the direction of the currents in the wire and the coil?

	In Wire	In Coil
a)	From P to Q	anticlockwise
b)	From P to Q	clockwise
c)	From Q to P	anticlockwise
d)	From Q to P	clockwise

9. Why are lighting and power circuits in homes, different?
- All the lights and appliances do not fit onto one circuit
 - Lights draw less current than most appliances
 - A larger fuse is required for the lighting circuit
 - Appliances draw less current than lights
10. A 240V electric kettle has a heating element with resistance of 20 ohm. The kettle boils a set volume of water in 2 minutes. Assuming 100% efficiency, how much electrical energy is used to boil this water?
- 5 760 J
 - 9 600 J
 - 345 600 J
 - 580 800 J

11. In a particular star, both hydrogen and helium are reactants in energy producing reactions. To which group of stars does this star belong?
- black holes
 - main sequence
 - red giants
 - white dwarfs
12. The Copernicus model of the universe improved on earlier models, especially in explaining which aspect of the universe?
- the phases of the moon
 - shooting stars
 - sunrise and sunset
 - the observed motions of the stars and planets
13. What quantity, which was previously thought not to be energy, did Einstein theorise as being the equivalent of energy?
- the speed of light
 - power
 - mass
 - work
14. Which characteristic of a star is directly related to its colour?
- composition
 - size
 - gas pressure
 - temperature
15. Modern cars are designed with crumple zones for safety reasons. Which of the following describes the effect of the crumple zone to the impulse, force and time of a collision in which a car's speed is reduced to zero?

	Impulse	Force	Time
a)	Decreased	Decreased	Same
b)	Decreased	Increased	Decreased
c)	Same	Increased	Decreased
d)	Same	Decreased	Increased

End of Section I

Student Name: Teacher's Name:

BAULKHAM HILLS HIGH SCHOOL

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2009

YEAR 11

PHYSICS

MULTIPLE CHOICE ANSWER SHEET

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
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D

Section II

57 marks

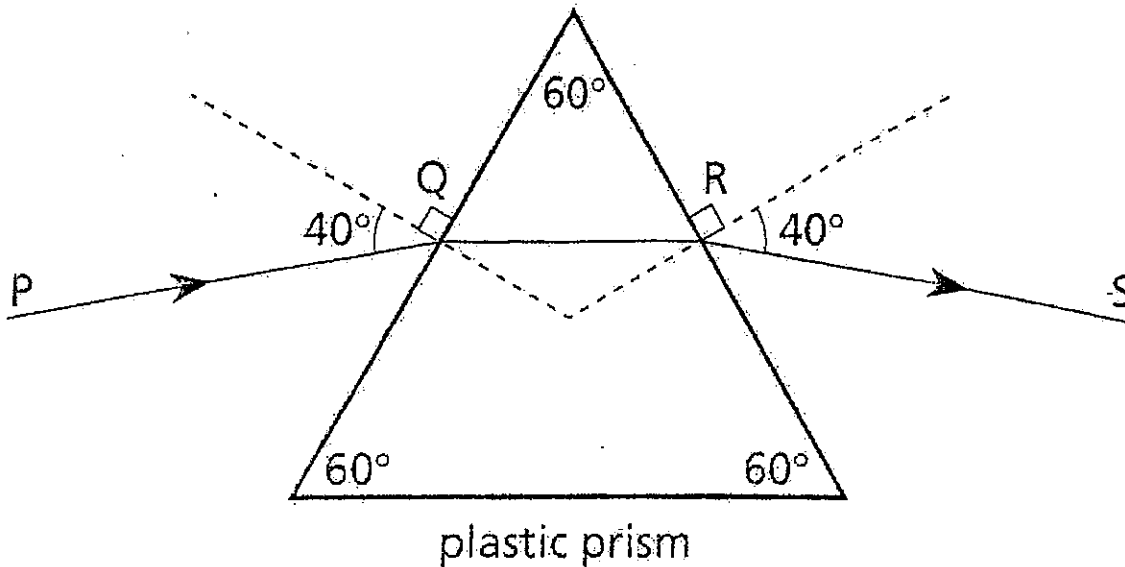
Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations

Question 16 (5 marks)

Marks

- a) The diagram shows the path of a monochromatic beam of light through a triangular prism. (Note: QR is parallel to the base of the triangular plastic prism)



- i) Calculate the refractive index of the plastic. 2

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- ii) Add to the drawing the path which the ray PQ would take from Q if the prism were made from a plastic with a **slightly higher** refractive index. 2

- b) The original prism is now replaced with one of the same size and shape but made from glass of refractive index 1.80.

Calculate the critical angle for this glass. 1

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Question 17 (3 marks)

Describe ONE application of a *concave* reflecting surface.
Include a sketch to illustrate your answer.

3

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Question 18 (2 marks)

The electromagnetic radiation that reaches the outer atmosphere of the Earth is approximately 2
approximately 1400 Wm^{-2} .

If the distance from the Sun to the Earth is $1.4 \times 10^{11} \text{ m}$ and the distance from the Sun to Uranus
is $2.8 \times 10^{12} \text{ m}$, determine the intensity of the electromagnetic radiation reaching Uranus.

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Question 19 (2 marks)

Identify a region of the electromagnetic spectrum that is not filtered out by the Earth's 2
atmosphere and is used for communication purposes and explain how it is detected.

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Question 22 (2 marks)

Discuss how the main sources of domestic energy have changed over time.

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Question 23 (4 marks)

Describe an *experiment* you have done in the laboratory to investigate the relationship between current, voltage and power for a heating coil.

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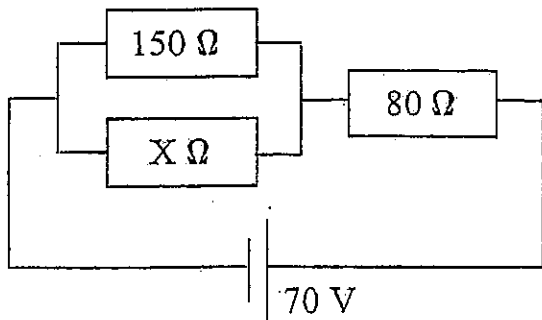
In your answer, outline how the results were analysed.

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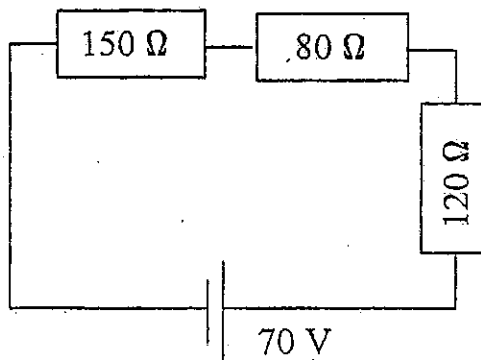
Question 24 (5 marks)

Consider the following two electrical circuits:

Circuit Y



Circuit Z



a) Calculate the current flowing in **circuit Z**.

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b) The current flowing through the 150 ohm resistor in each circuit is the same.

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Using this information and your answer from a) to determine the *potential difference* across the 80 Ω resistor in circuit Y.

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c) Determine the value of resistor X.

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Question 25 (2 marks)

A household switches off four appliances which are in standby mode all day, every day. Each of the appliances consumes 10W in standby mode.

2

Calculate the reduction in electrical consumption in *kilowatt-hours* each year when these appliances are switched off, assuming that they are never used in the year.

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Question 26 (3 marks)

A domestic circuit consists of some 240V electrical appliances as listed below.

Appliance	Power Rating
Cooker Lamp	50 W
Air Conditioner	1800 W
Refrigerator	120 W
Cooker	2400 W
Kettle	1500 W

a) Calculate the current passing through the Air Conditioner.

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b) Explain which is the most suitable fuse (5A, 10A or 15A) for the Air Conditioner,

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Question 27 (2 marks)

Compare the magnetic field associated with a solenoid and a bar magnet.

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Question 28 (4 marks)

Discuss the radiation emitted by hot bodies at specific temperatures and how this relates to the stars.

4

Illustrate your answer with a fully labelled graphical diagram.

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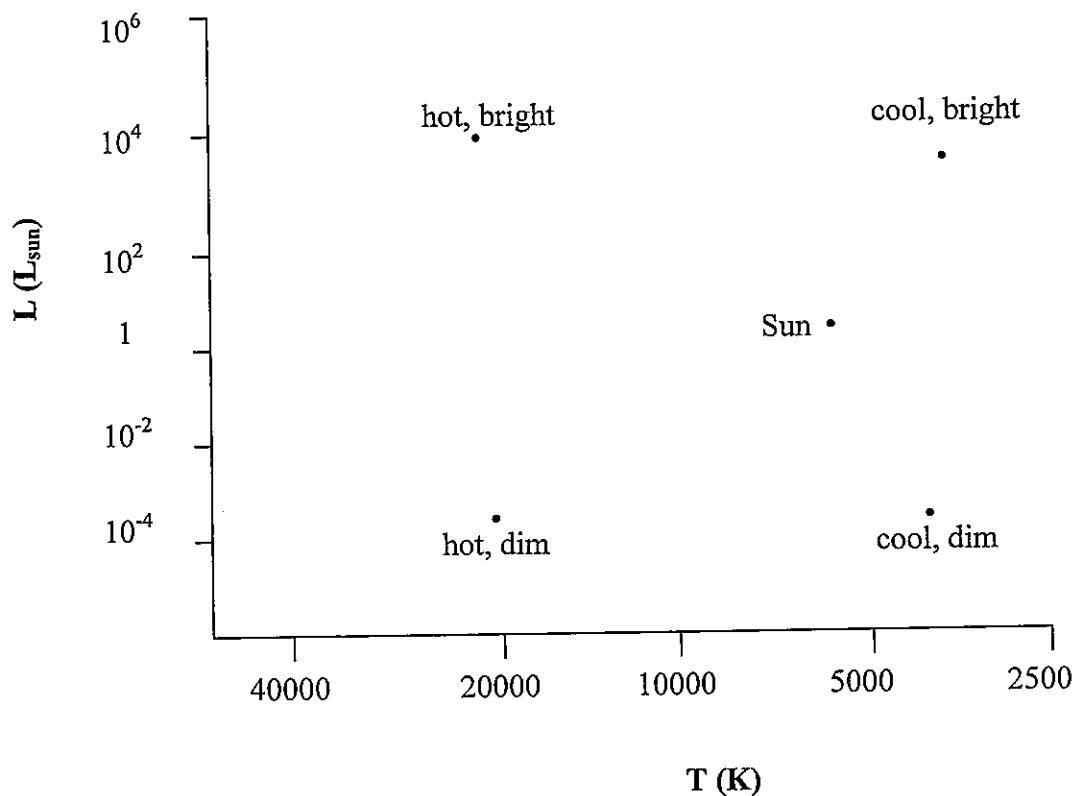
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Question 29 (4 marks)

The *Hertzsprung-Russell Diagram* below is incomplete.



a) On the diagram, outline the area referred to as the *Main Sequence*. 1

b) Identify the type of star represented as "cool, bright". 1

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c) Discuss use of *colour* to label the horizontal axis instead of temperature. 2

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Question 30 (3 marks)

Over recent decades, studies into the nature of the solar wind have revealed detailed information as to its nature and behaviour.

- a) Outline the nature of the solar wind. 1

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- b) Outline some of the impacts of the solar wind on Earth and on our society. 2

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Question 31 (5 marks)

- a) Compare the *ionising* power AND *penetrating* power of alpha, beta and gamma radiation. 2

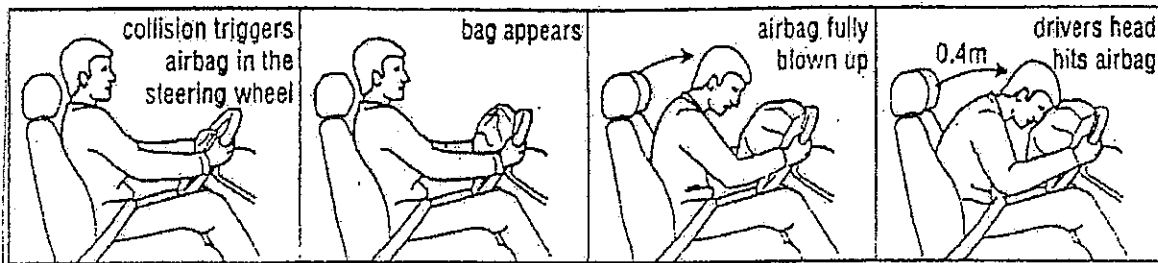
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- b) Explain why and describe how *electric fields* may be used to distinguish between alpha, beta and gamma radiation. 3

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Question 32 (4 marks)

The diagram below shows an airbag inflating during a car collision.



A car of mass 420kg was travelling at 60kmh^{-1} when a force of 5000 N (assumed constant) reduced its speed to zero in a collision.

- a) Explain how the airbag reduces injury to a driver. 2

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- b) Recall another feature of modern cars that helps reduce injury to passengers. 1

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- c) Identify ONE *energy transformation* that occurs during a collision. 1

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End of Paper

BHHS Y11 PHYSICS YEARLY 2009

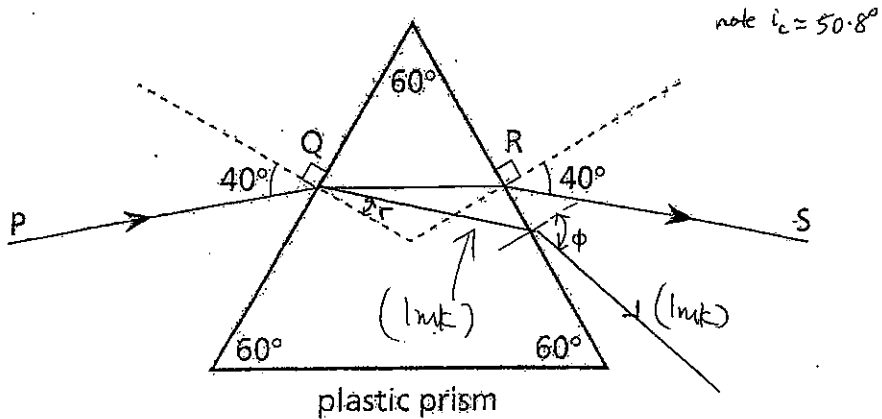
Section II
 11C 2B 3B 4B 5D 6B 7B 8C
 9B 10C 11C 12D 13C 14D 15D

57 marks
 Answer the questions in the spaces provided.
 Show all relevant working in questions involving calculations

Question 16 (5 marks)

Marks

- a) The diagram shows the path of a monochromatic beam of light through a triangular prism. (Note: QR is parallel to the base of the triangular plastic prism)



- i) Calculate the refractive index of the plastic. 2

(r) angle of refraction = 30°
 refractive index = $\frac{\sin i}{\sin r} = \frac{\sin 40^\circ}{\sin 30^\circ}$ (1mk)

refractive index = 1.29 (1mk)

- ii) Add to the drawing the path which the ray PQ would take from Q if the prism were made from a plastic with a slightly higher refractive index. 2
 1mk (for line drawn from Q into prism, with r less than 30°)
 1mk (for line drawn out of prism, with ϕ greater than 40°)
- b) The original prism is now replaced with one of the same size and shape but made from glass of refractive index 1.80.

Calculate the critical angle for this glass. 1

refractive index = $\frac{1}{\sin i_c}$ where i_c = critical angle

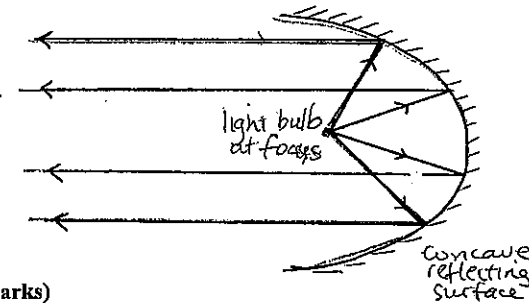
$\therefore \sin i_c = \frac{1}{1.80}$

$\therefore i_c = 33.7^\circ$

Question 17 (3 marks)

Describe ONE application of a concave reflecting surface. Include a sketch to illustrate your answer. 3

(A concave reflecting surface is used by car headlight reflectors). (The light bulb is placed at the focus of the parabolic reflector so that rays incident on the reflector are reflected straight out in front of the car) (1mk)



labelled diagram, shows arrows (1mk)

Question 18 (2 marks)

The electromagnetic radiation that reaches the outer atmosphere of the Earth is approximately 1400 Wm⁻². 2

If the distance from the Sun to the Earth is 1.4×10^{11} m and the distance from the Sun to Uranus is 2.8×10^{12} m, determine the intensity of the electromagnetic radiation reaching Uranus.

$$\frac{I_u}{I_e} = \frac{d_e^2}{d_u^2}$$

$$I_u = \frac{(1.4 \times 10^{11})^2}{(2.8 \times 10^{12})^2} \times 1400 \quad (1mk)$$

$$I_u = 3.5 \text{ Wm}^{-2} \quad (1mk)$$

Question 19 (2 marks)

Identify a region of the electromagnetic spectrum that is not filtered out by the Earth's atmosphere and is used for communication purposes and explain how it is detected. 2

(Radio waves maybe detected on Earth by an antenna which consists of a piece of metal). The electrons in the metal antenna are subjected to the electric field of the radio wave. They therefore oscillate with the same frequency of the radio wave creating an alternating current. (1mk)

For visible light: total internal reflection in optic fibre. (2marks)
 visible light detected using eye / photographic film (1mark)

Question 20 (3 marks)

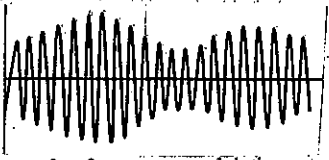
Draw diagrams to show the following:

a) A radio carrier wave



1

b) The carrier wave after amplitude modulation



1

c) The carrier wave after frequency modulation



1

Question 21 (4 marks)

In your course of study this year you researched information to determine the underlying physical principles used in the application of physics related to waves on either the Global Positioning System, CD technology, the Internet or DVD technology.

4

Choose ONE of these and discuss these underlying physical principles.

- states what it is and its function (1mk)
- involves microwave / radio wave / laser (1mk)
- explains clearly how it works (1mk)
- relates to properties of wave (1mk)
 - eg. speed of light
 - * refraction
 - * reflection
 - * interference

Q22. Describe TWO sources of domestic energy that have changed over time.
Describe ONE source

2 mks
1 mk

Q23 Many students did not read this question properly. You were asked to describe an experiment that used a heating coil to investigate the relationship between current, voltage and power. The only experiment that fitted this description involved a heating coil in a container of water. Other experiments did not answer the question.

The following points needed to be parts of your answer:

Coil in circuit, measure current, measure voltage, record time, measure temperature increase, measure volume of water used, calculate energy used ($E = V.I.t$ in Joules), compare energy used with energy to increase that volume of water by the same temperature ($\Delta H = m.c.\Delta t$).

7 – 8 points 4 mks 5 – 6 points 3 mks
2 – 4 points 2 mks 1 point 1 mk

Q24 At the beginning of Section II you were told to “Show all relevant working in questions involving calculations”. In your H.S.C. exams, Trial H.S.C. exams and other tasks, marks are awarded for working shown. If you make a mistake in your answer you can gain marks for your working. If you write down an answer and do not show working you risk losing all your marks for the question. If you just write down an answer, and you have made a mistake you will receive 0, even in the H.S.C. Be warned!!!

a) Total resistance = $150 + 80 + 120 = 350\Omega$

$$V = IR$$

$$I = V / R = 70 / 350$$

$$I = 0.2A$$

1 mk

b) $PD_{150} = 150 \times 0.2 = 30V$

$$\therefore PD_{80} = 70 - 30 = 40V$$

1 mk

1 mk

c) $PD_{150} = PD_X = 30V$

$$PD_{80} = 40V = I \times 80$$

$$\therefore I_{80} = 0.5A$$

$$\therefore I_X = 0.5 - 0.2 = 0.3A$$

$$PD_X = 30 = 0.3 R_X$$

$$\therefore R_X = 30 / 0.3 = 100\Omega$$

1 mk

1 mk

Q25 $10W = 10J / sec$

Energy saved in a year = $(4 \times 10 \times 365 \times 24) / 1000$

$$= 350.4 kWh$$

1 mk

1 mk

Q26

a) $P = VI$ so $I = 1800 / 240 = 7.5A$

1 mk

b) 10A is most suitable fuse

1 mk

If 5A fuse is used, it will “blow” every time A/C is switched on, as $7.5 > 5$. 15A is also not suitable. If there was an electrical problem, current could almost double while A/C continued to operate, risking damage to motor, or risk of electrocution.

1 mk

Q27

Bar magnet’s field is fixed, and external.

Solenoid’s field is variable, depending on strength and direction of electric current.

Solenoid’s field is both external and internal.

2 mks

Question 27 (2 marks)

Compare the magnetic field associated with a solenoid and a bar magnet.

2

See previous page.

Question 28 (4 marks)

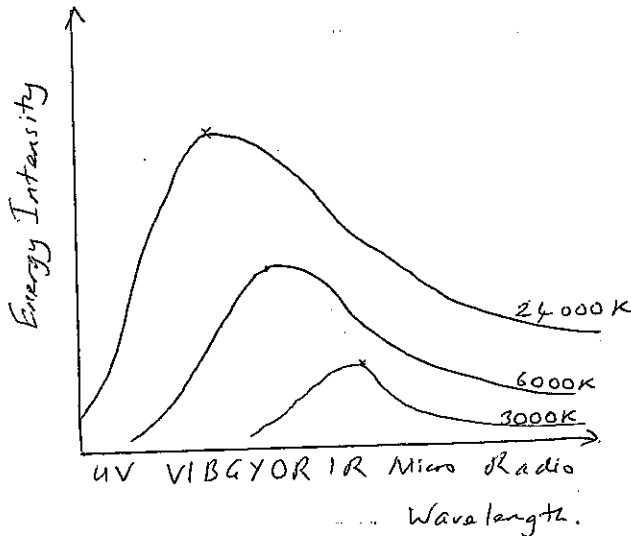
Discuss the radiation emitted by hot bodies at specific temperatures and how this relates to the stars.

4

Illustrate your answer with a fully labelled graphical diagram.

Must mention

Dominant wavelength of radiation is lower as temperature increases. 1 mark
 Stars are near ideal black bodies or similar informative statement relevant to radiation from stars and black body radiation. 1 mark

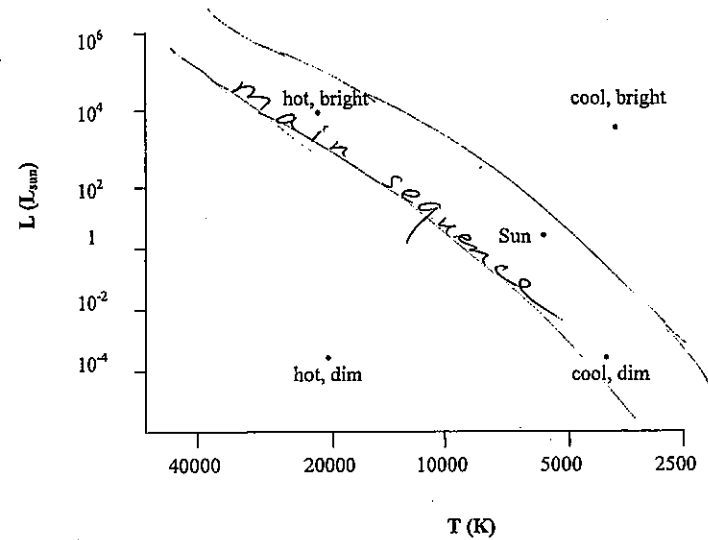


2 marks for correct graph.

0 marks awarded for graph if there are 2 serious errors or omissions in the graph.

Question 29 (4 marks)

The Hertzsprung-Russell Diagram below is incomplete.



a) On the diagram, outline the area referred to as the Main Sequence. 1

b) Identify the type of star represented as "cool, bright". 1

Red Giants

c) Discuss use of colour to label the horizontal axis instead of temperature. 2

Temperature determines dominant wavelength and hence colour. High Temp. (left side of scale) blue or blue-white. Low Temp. (right side of scale) red.

Question 30 (3 marks)

Over recent decades, studies into the nature of the solar wind have revealed detailed information as to its nature and behaviour.

a) Outline the nature of the solar wind.

Consists mostly of ionised hydrogen (proton + electrons) & some ionised heavier elements, streaming out from the sun at high velocity.

Must mention ionised or charged. & name the particles

b) Outline some of the impacts of the solar wind on Earth and on our society.

any 2 of, 1 mark each

- Communication difficulties (interference)
- Damage to power grids due to excess current
- Cause Auroras at the poles
- Dangerous radiation (mainly for plane passengers & astronauts)
- Expansion of the atmosphere causing drag on satellites

Note: Must be specific

Question 31 (5 marks)

a) Compare the ionising power AND penetrating power of alpha, beta and gamma radiation.

	Ionising Power	Penetrating Power
α	very high	very low <i>stopped by paper</i>
β	moderate	a few metres in air <i>stopped by aluminium</i>
γ	low	very high <i>can even pass through several cm of lead</i>

Correct order 1 mark
Correct order with relevant detail 1 mark

b) Explain why and describe how electric fields may be used to distinguish between alpha, beta and gamma radiation.

+++++ β → Nuclear radiation directed between charged plates @ 90° to field lines.

α (is) deflected slightly towards negative because like charges attract. & because α is heavy (significant momentum)

β (is) deflected strongly towards positive plate

γ not deflected because γ is not charged.

Note: α attracted to -ve
 β attracted to +ve
 γ straight through

Question 32 (4 marks)

The diagram below shows an airbag inflating during a car collision.



A car of mass 420kg was travelling at 60kmh^{-1} when a force of 5000 N (assumed constant) reduced its speed to zero in a collision.

a) Explain how the airbag reduces injury to a driver.

with Air Bag compared to hitting steering wheel

- larger stopping time (1)
- shorter stopping time
- less force
- more force
- less bodily injury (1)

b) Recall another feature of modern cars that helps reduce injury to passengers.

seat belts, crumple zone
OR headrest OR ABS Anti-lock Brakes

c) Identify ONE energy transformation that occurs during a collision.

kinetic energy to heat energy
OR kinetic energy to sound energy