

2005

Year 11 Half Yearly Examination

HSC Course

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 1 hour
- Write using blue or black pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your name on each answer sheet

Total marks

40

Section A

10 multiple choice worth 1 mark each

Section B

Short answer questions worth 30 marks

TIC: Mr Coombes

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Data and equations

Speed of light in a vacuum is $3 \times 10^8 \text{ ms}^{-1}$

Speed of sound in air is 340 ms^{-1}

Force of gravity on Earth is 9.8 N kg^{-1}

$$v_{av} = \frac{\Delta r}{\Delta t}$$

$$v_1/v_2 = \sin i / \sin r$$

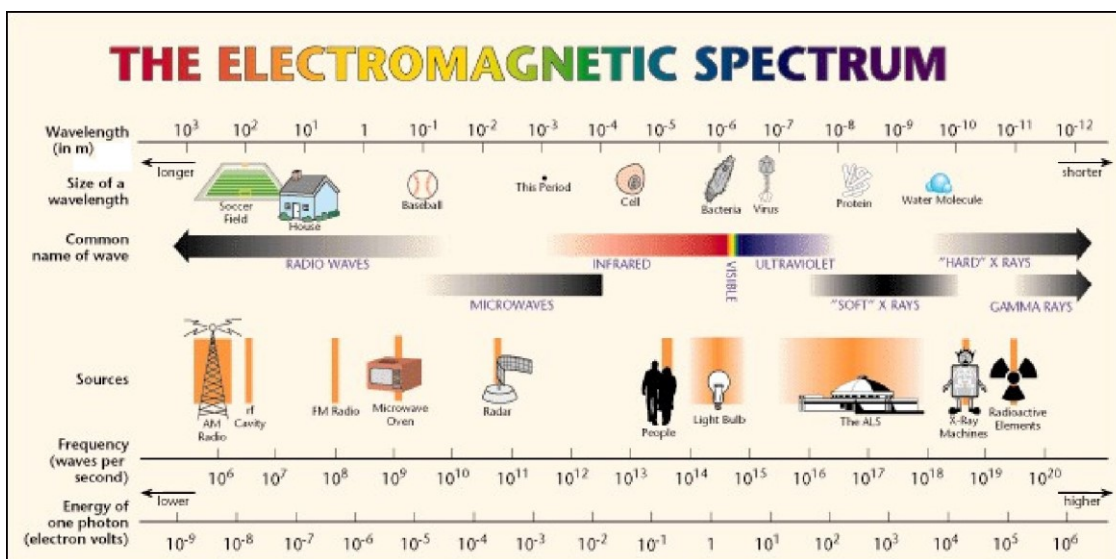
$$v = f\lambda$$

$$T = \frac{1}{f}$$

Section A

10 multiple choice questions worth one mark each

1. Use the following chart, which shows information about the components of the electromagnetic spectrum, to answer this question.



Waves having frequencies greater than about $5 \times 10^{14} \text{ Hz}$ are **not** used for communication of information. Which of the following types of electromagnetic waves are not used for communication?

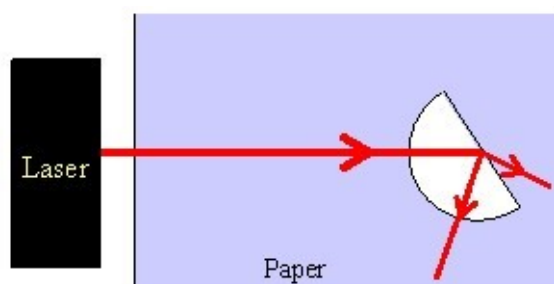
- (A) Ultraviolet
- (B) Gamma
- (C) Visible light
- (D) Radio

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2. Tri-Band is a term applied to mobile telephones that are capable of operating on any of the three internationally designated GSM frequency bands, i.e. GSM 900 (900 MHz), GSM 1800 (1800 MHz) and GSM 1900 (1900 MHz). Australian mobile phones use the lower frequencies and mobile phones in the United States use the highest of these frequencies.

What is the wavelength, in metres, used by mobile telephones in the United States?

- (A) 5.7×10^{17}
(B) 1.579×10^{-1}
(C) 1579
(D) 5.7×10^{11}
3. The following diagram shows a light source (laser beam) in air directing a beam of light onto a semicircular glass prism. The beam enters the prism at the curved surface and travels through the prism to the flat surface as shown. The point at which the ray meets the flat surface is the centre of the circular part of the prism.



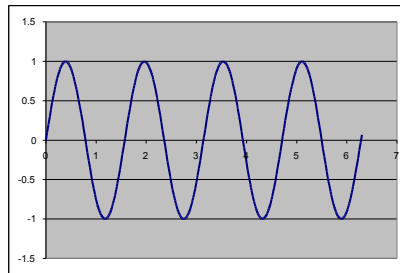
Imagine that the prism was now rotated anticlockwise around an axis through the point where the light strikes the flat surface.

Which of the following statements best describes the behaviour of the light ray if this happens?

- (A) The light path through the curved surface will not be altered and the angle of refraction of the ray leaving the prism will increase.
(B) The light path through the curved surface will not be altered and the angle of reflection of the ray inside the prism from the plane surface will decrease.
(C) The light passing through the curved surface will be refracted more towards the upper corner of the prism and the angle of refraction of the ray leaving the prism will decrease.
(D) The light passing through the curved surface will be refracted more towards the upper corner of the prism and the angle of reflection of the ray inside the prism from the plane surface will increase.

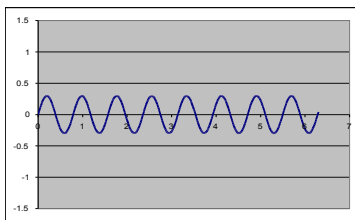
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4. Which of the following statements is **incorrect**.
- (A) AM waves have a lower frequency than FM waves.
 - (B) FM waves carry more information than AM waves.
 - (C) Sound waves have a lower frequency than both AM and FM carrier waves.
 - (D) FM waves can travel a larger distance than AM waves.
5. The following diagram represents a sound waves being analysed using a cathode ray oscilloscope.

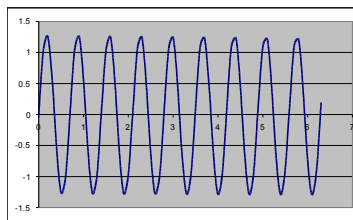


Compared to the sound represented by the graph above, which graph below represents a louder sound with a higher frequency?

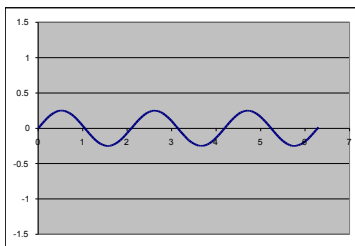
(A)



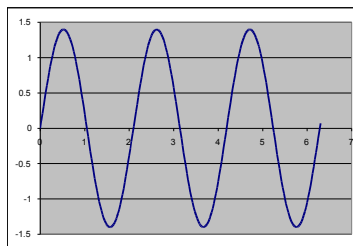
(B)



(C)



(D)



6. Which of the following is **not** true about a mechanical wave
- (A) It requires a medium in which to travel.
 - (B) It transports energy and matter from one point to another.
 - (C) The particles may oscillate in a direction parallel to the energy propagation.
 - (D) The frequency of the wave is determined by the source.

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7. The light intensity from two identical stars, A and B, is measured from the Earth. Light from the star B is measured to have 9 times the intensity as coming from star A. 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) 333000 light years
 - (D) 9 million light years
8. A sailor at sea carefully observes the crests of the waves passing his ship. The time between successive crests is 15 s. The height of the waves is 7 m and the distance between the crests is about 45 m. Ignoring any motion of the boat, the speed of the waves is closest to which of the following values?
- (A) 3 ms^{-1}
 - (B) 675 ms^{-1}
 - (C) 10 ms^{-1}
 - (D) 6.4 ms^{-1}
9. Jill wants to calculate the distance from her position to a large cliff. She fires a starting gun and times how long it takes for the echo to return. It takes 1.5 seconds for the echo to return. Calculate the distance to the cliff in kilometres. The distance is closest to
- (A) 0.26 km
 - (B) 0.51 km
 - (C) 510 km
 - (D) $2 \times 10^8 \text{ km}$
10. Which best describes the behaviour of light entering a glass prism.
- (A) The light bends towards the normal and the wavelength increases.
 - (B) The light bends towards the normal and the wavelength decreases.
 - (C) The light bends away from the normal and the wavelength decreases.
 - (D) The light bends away from the normal and the wavelength increases.

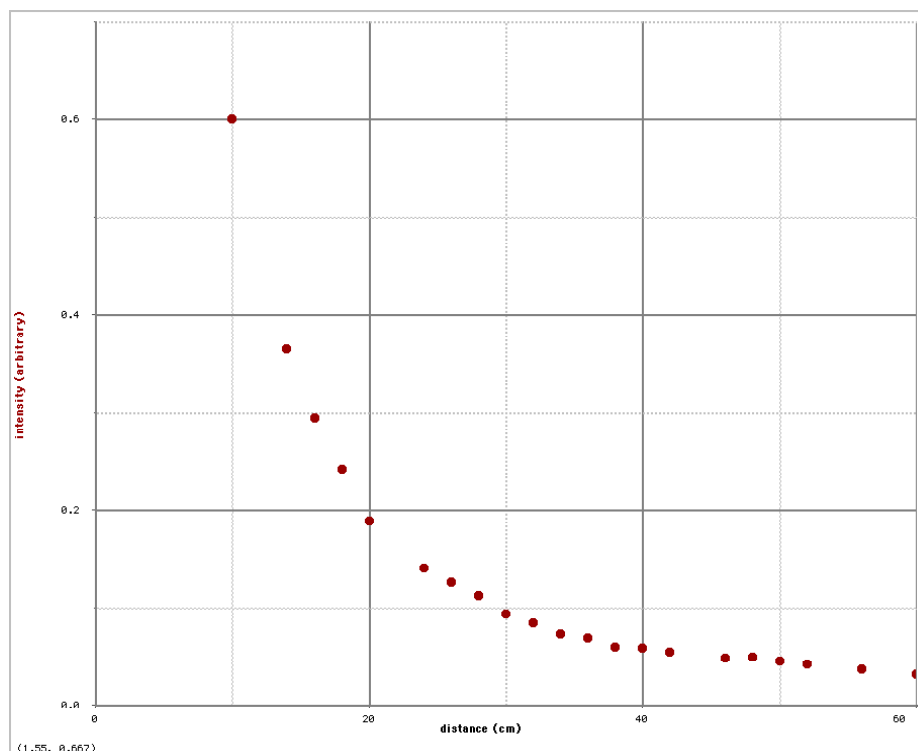
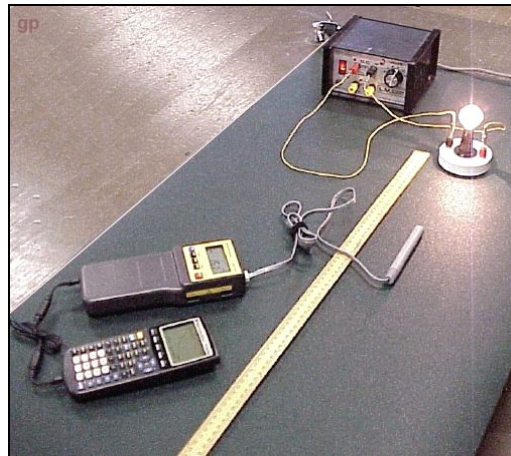
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Section B

This section is worth 30 marks.

Attempt all questions.

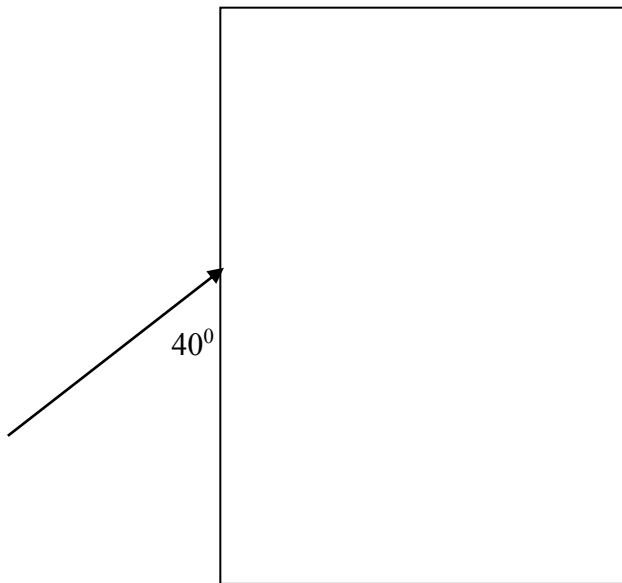
11. The apparatus shown in the photograph below was used to conduct a first-hand investigation of the properties and behaviour of light and the graph shows the data collected during this investigation.



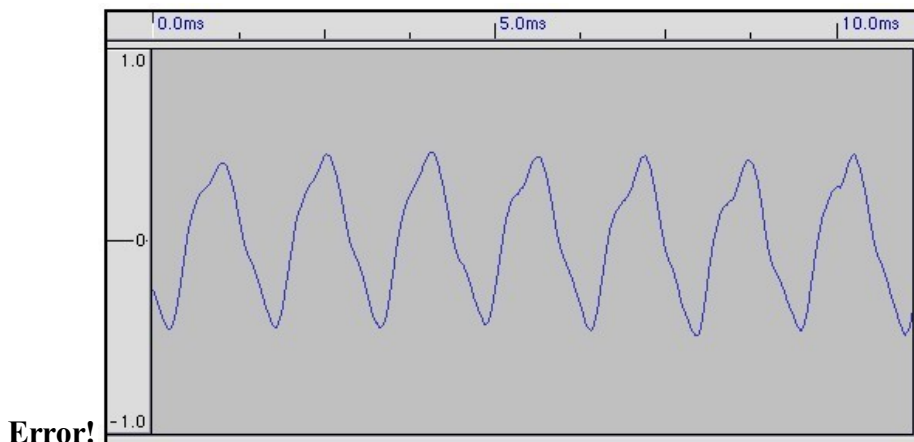
- (a) Using the graph identify the intensity of the light at a distance of 20cm. **(1 mark)**
- (b) Predict a possible relationship between the variables measured that is evident from this graph. **(1 mark)**
- (c) Suggest another graph that could be constructed to enable the mathematical relationship between these variables to be deduced. **(1 mark)**

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12. The speed of light in a glass prism is $1.8 \times 10^8 \text{ ms}^{-1}$. Light enters the prism as shown below.

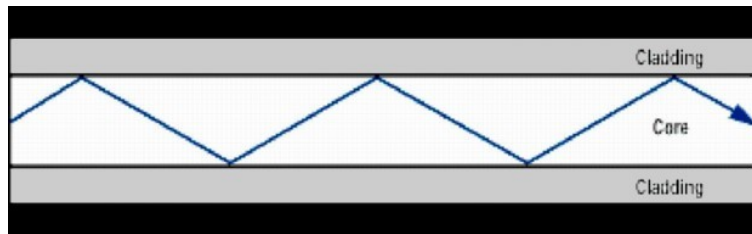


- (a) Calculate the angle of refraction for the light entering the prism. **(2 marks)**
- (b) Calculate the critical angle for light within the prism. **(2 marks)**
13. Define the following terms as they apply to waves
- Period
 - Compression
 - Transverse Wave
- (4 marks)**
14. The following is a pressure / time graph representation produced by the Audacity program. The horizontal axis units are milliseconds. Calculate the frequency and wavelength of the sound wave represented by this graph. **(3 marks)**

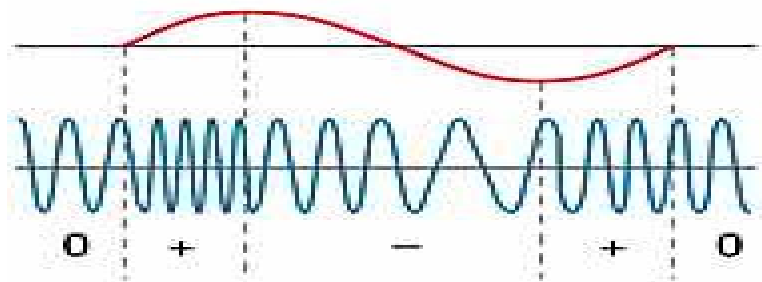


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15. The following diagram shows a cross-sectional view of an optical fibre. Explain how the light is able to stay within the core of the optical fibre. **(3 marks)**



16. The following diagram shows a modulated radio wave.
- Identify the type of modulation represented by this graph. **(1 mark)**
 - Outline the process used to produce this modulated wave and explain how this method encodes information. **(3 marks)**



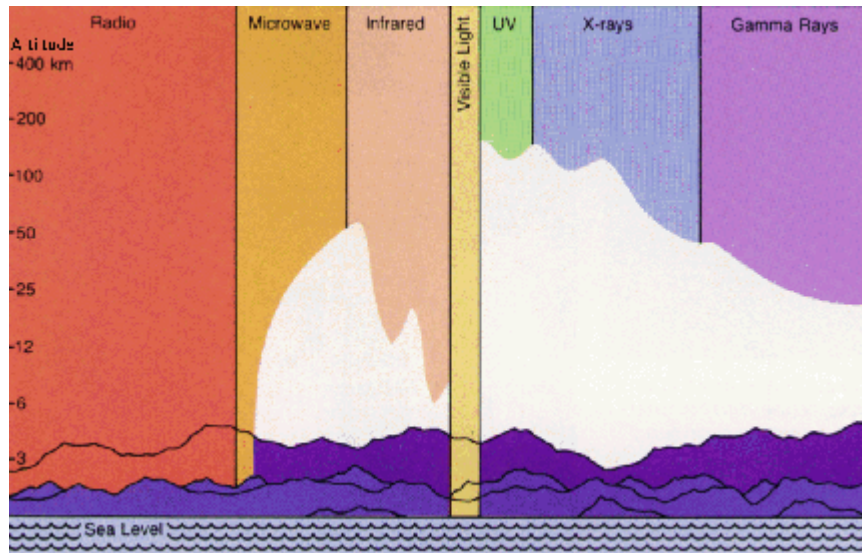
17. An investigation of the relationship between frequency and wavelength for a sound wave was carried out. The following data was collected by Johnny in this investigation. Johnny predicts from the data that frequency is inversely proportional to wavelength.

Frequency (Hz)	Wavelength (cm)	
860	40	
570	60	
410	80	
350	100	
290	120	
240	140	
200	160	
190	180	

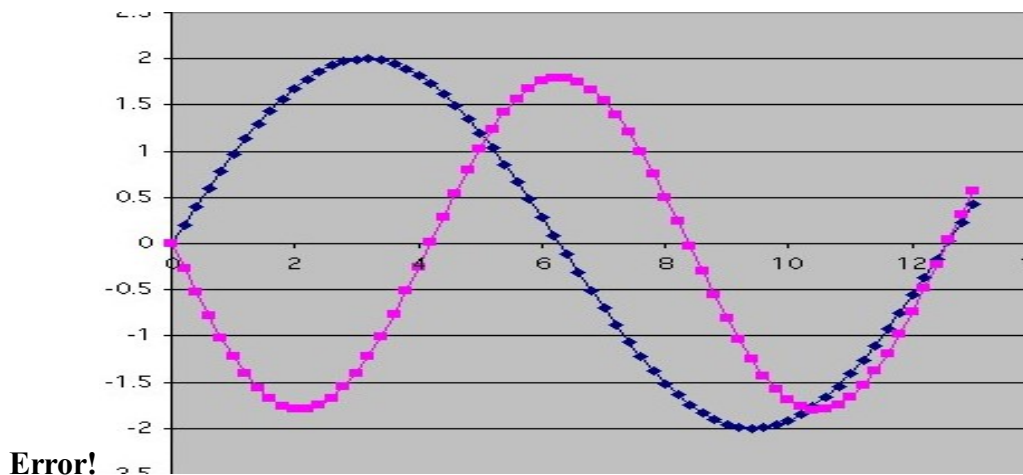
Create a third set of values in the table above and then plot a graph that will demonstrate that frequency is inversely proportional to wavelength. **(4 marks)**

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18. Describe two ways in which the application of the reflection of radio waves has assisted in information transfer. **(2 marks)**.
19. The following diagram shows the ability of different types of electromagnetic radiation to penetrate the atmosphere. Identify the two types of radiation which could provide Earth based astronomers with useful information about a distant galaxy. **(1 mark)**



20. For the two transverse waves shown below sketch the resultant wave that would result if the two were added together. **(2 marks)**



[end of paper]

Section A Answer Sheet

Use of the multiple-choice answer sheet.

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

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

1. (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.

1. (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:

1. (A) (B)

correct
↓

(C) (D)

Total marks (10)

Attempt all questions 1 – 10

- 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)

Write your answers in the spaces provided.

11.

(a)

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(b)

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(c)

.....

3 M

12. (a)

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(b)

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2M

13. (a)

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(b)

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(c)

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4M

14.

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3M

15

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3M

16. (a)

1 M

(b)

3M

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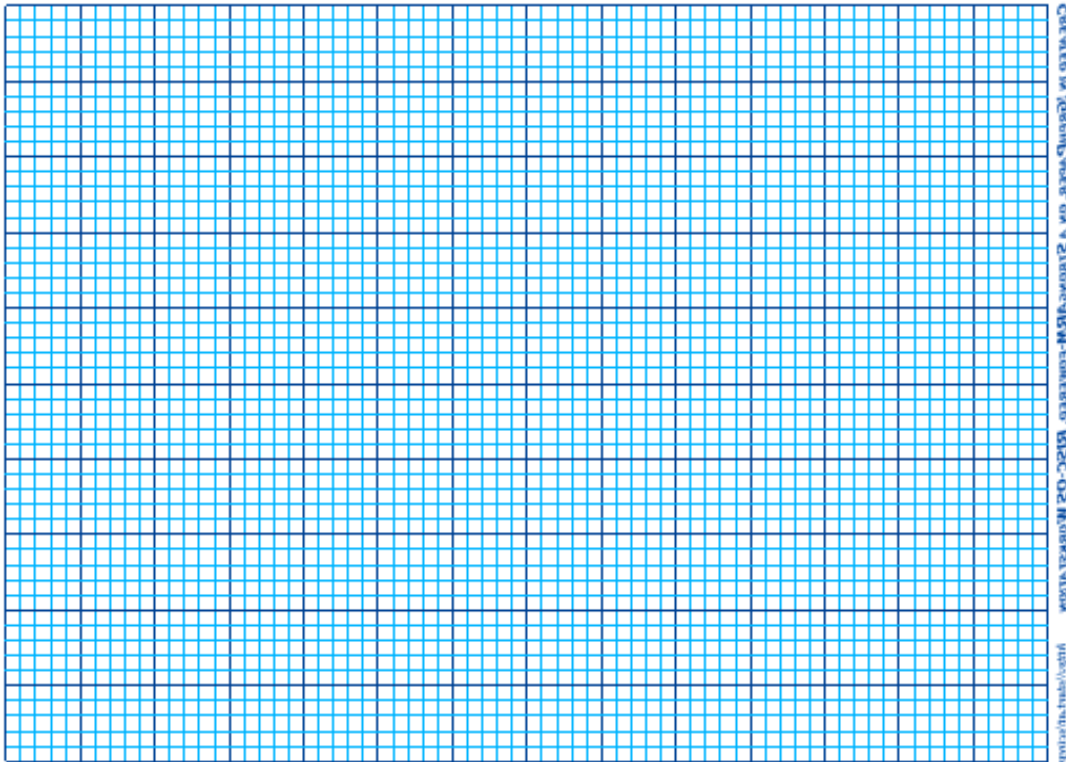
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17.

Frequency (Hz)	Wavelength (cm)	
860	40	
570	60	
410	80	
350	100	
290	120	
240	140	
200	160	
190	180	



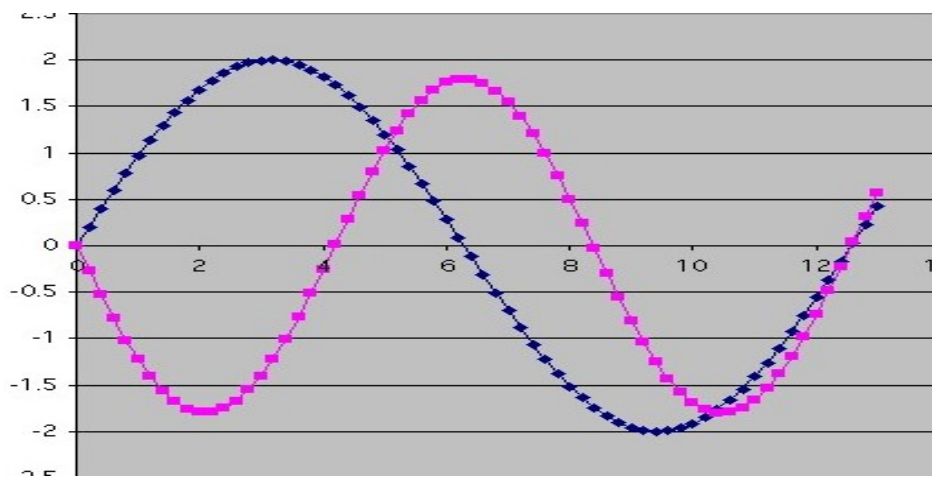
18.
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.....
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2 M

19.
.....
.....

1 M

20.



End of Exam

Marking Scheme Physics HY Year 11 2005

Question 11 (a)

Criterion	Mark/s
States reasonable value of intensity (range 0.18-2.0)	1

Question 11 (b)

Criterion	Mark/s
Suggests a plausible relationship (Intensity inversely proportional to distance or distance squared)	1

Question 11 (c)

Criterion	Mark/s
Identifies an appropriate graph (Intensity vs 1/ distance or Intensity vs 1/distance ²)	1

Question 12 (a)

Criterion	Mark/s
Identifies and states the correct formula (Snell's Law) and substitutes appropriate data into formula and determines correct value of angle of refraction	2
Identifies and states the correct formula (Snell's Law) and substitutes appropriate data into formula but does not determine the correct value of angle of refraction	1 1/2
Identifies and states the correct formula (Snell's Law) and substitutes incorrect value of angle of incidence into formula and therefore does not determine the correct value of angle of refraction	1
Identifies and states the correct formula (Snell's Law)	1/2

Question 12 (b)

Criterion	Mark/s
Correctly substitutes into an appropriate formula to determine the critical angle	2
Substitutes into an appropriate formula but does not determine the correct value	1

Question 13

Criterion	Mark/s
Appropriate definitions given for each term e.g. (a) time taken for one wave to pass a given point or time taken for one complete oscillation of the wave (b) areas of high pressure in a longitudinal wave (c) waves in which vibration occurs in a direction perpendicular to the direction of propagation of the wave.	4
Two correct definitions	2
One correct definition	1

Question 14

Criterion	Mark/s
Determines the period (T) of the wave from the graph using more than two cycles of the wave AND Calculates the frequency using this figure ($f = 1/T$) AND Calculates the wavelength using ($\lambda = v/f = vT$)	3
Determines the period (T) of the wave from the graph using ONLY ONE cycle of the wave AND Calculates the frequency using this figure ($f = 1/T$) OR Calculates the wavelength using ($\lambda = v/f = vT$)	2
No correct determination of the period (T) but uses the correct method to calculate either the frequency ($f = 1/T$) OR the wavelength ($\lambda = v/f = vT$)	1

Question 15

Criterion	Mark/s
States that because the angle of incidence exceeds the critical angle the process of total internal reflection occurs because the cladding has a lower refractive index than the core	3
States that TIR occurs because the angle of incidence exceeds the critical angle	2
Identifies the process as total internal reflection	1

Question 16 (a)

Criterion	Mark/s
Identifies this as frequency modulation	1

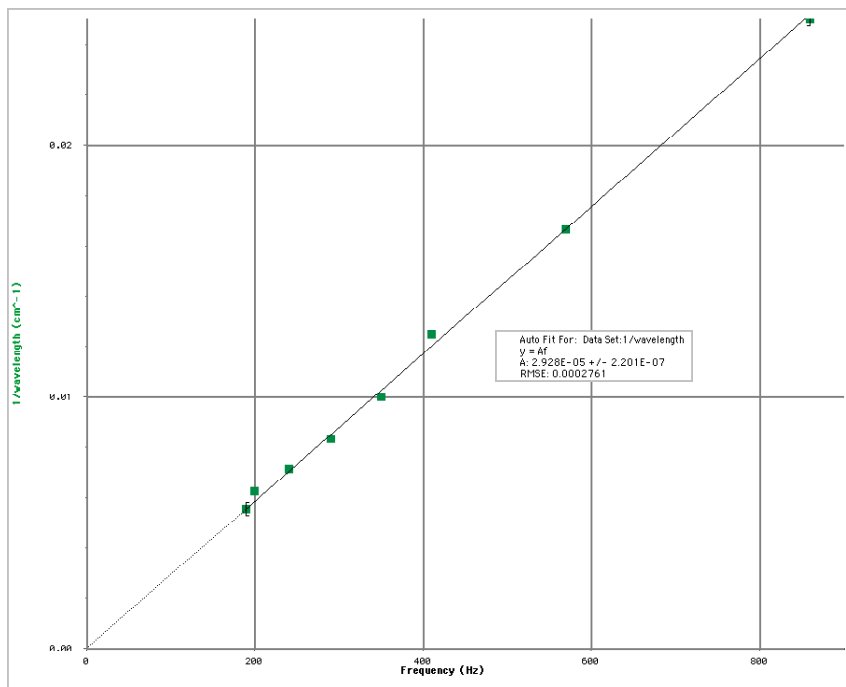
Question 16 (b)

Criterion	Mark/s
Describe using correct terminology the modulation of a carrier wave by a signal to produce a constant amplitude but varying frequency wave. A wave having varying amplitude and frequency (the signal) is used to change (modulate) the frequency of a carrier wave, which before the modulation process has a constant amplitude and frequency. The modulated carrier varies in frequency only and these frequency variations encode the variations in frequency AND amplitude of the original signal.	3
Mentions the combining of a signal and a carrier of constant amplitude in such a way that the resulting wave varies in frequency (only)	2
States that two waves are combined – mentions variation in modulated wave frequency	1

Question 17

Criterion	Mark/s
Tabulate a third column (1/wavelength or 1/frequency) and ... [no need to show table – implicit in graph] then plot this against the other variable (labelled axes, scale, units, correctly plotted points and line of best fit) and draw in a straight line of best fit. (see graph below – equation for line not required)	4
Tabulate appropriate third column then plot a graph with one item of key information missing e.g. axis label, units	3
plot a correct graph (one variable as inverse) with a major error such as an incorrect scale	2
Plot a graph of frequency vs wavelength with key information (see above) missing	1

Relationship between frequency and wave number (1/wavelength)



[equation for the line of best fit not required – use “X” for points marking points on hand-drawn graphs]

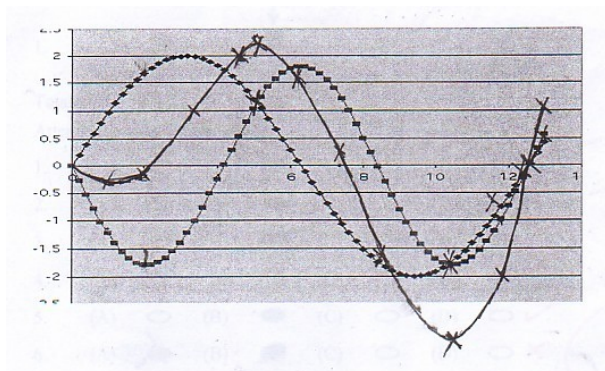
Question 18

Criterion	Mark/s
Give main feature of each of two ways waves used for information transfer are reflected e.g. radio waves are reflected from the ionosphere allowing transmission and then reception at widely separated points on the Earth’s surface; a parabolic dish is used to focus microwaves, by reflection, onto an antenna, thus intensifying the wave reaching the antenna	2
Give main feature of one way waves used for information transfer are reflected	1

Question 19

Criterion	Mark/s
Recognises and names the two types of radiation for which all wavelengths penetrate the Earth’s atmosphere from space to the Earth’s surface (radio and visible light). ½ mark awarded also for microwaves BUT must have stated that only the longest wavelength microwaves can be detected as most microwaves do not readily pass through the atmosphere)	1

Question 20



sample answer

Other possible graphs for question 17

