

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
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8	
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10	
TOTAL	



General Certificate of Education
Advanced Subsidiary Examination
June 2010

Physics (B): Physics in Context PHYB1

Unit 1 Harmony and Structure in the Universe

Module 1 The World of Music

Module 2 From Quarks to Quasars

Thursday 27 May 2010 1.30 pm to 2.45 pm

For this paper you must have:

- a pencil and a ruler
- a calculator
- a Data and Formulae Booklet.

Time allowed

- 1 hour 15 minutes

Instructions

- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 70.
- You are expected to use a calculator where appropriate.
- A *Data and Formulae Booklet* is provided as a loose insert.
- You will be marked on your ability to:
 - use good English
 - organise information clearly
 - use specialist vocabulary where appropriate.

Advice

- You are advised to spend about 20 minutes on **Section A** and about 55 minutes on **Section B**.



JUN10PHYB101

WMP/Jun10/PHYB1

PHYB1

Section A

Answer **all** questions in this section.

There are 20 marks for this section.

- 1 (a) (i)** A listener is disturbed by a noise which has an intensity level of 75 dB.
State the full name of the unit dB.

.....
(1 mark)

- 1 (a) (ii)** State how the loudness experienced by the listener would change if the noise's intensity level were to be reduced to

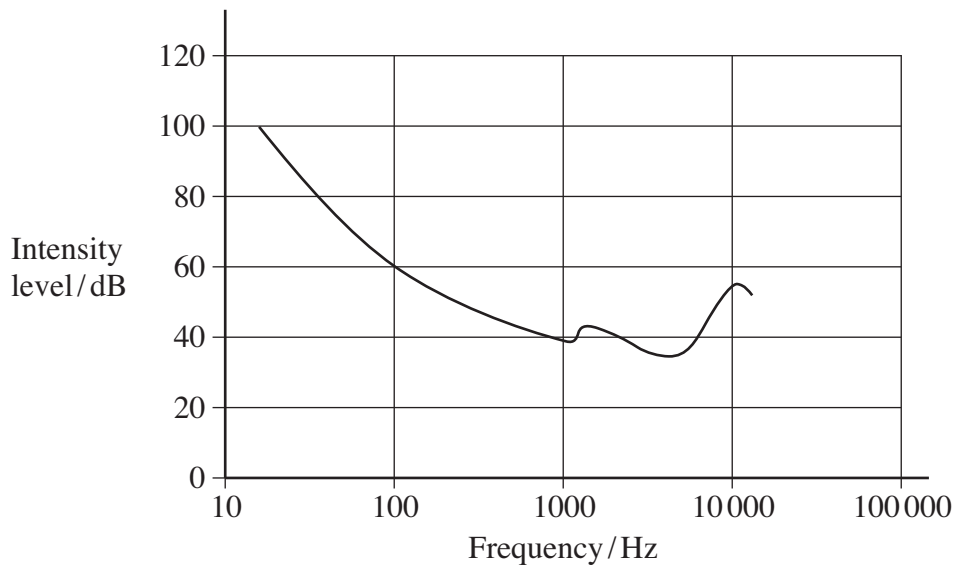
72 dB

66 dB

(2 marks)

- 1 (b)** The graph below shows a curve of equal loudness for a young person with good hearing.

- 1 (b) (i)** Sketch on the graph another curve for sound perceived to be of equal loudness to the original curve's sound for the same person when they are significantly older.



(2 marks)

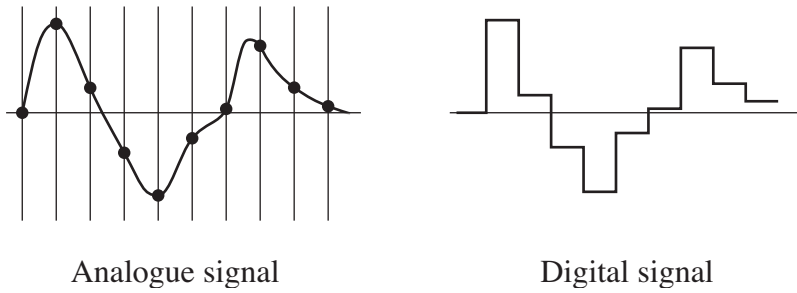
- 1 (b) (ii)** State **one** factor, apart from age, that can cause deterioration in hearing.

.....
(1 mark)



2 (a) Figure 1 shows an analogue signal and its conversion to a digital signal.

Figure 1



2 (a) State **two** ways in which the quality of the digital signal could be improved.

first way

second way (2 marks)

2 (b) (i) State why compression techniques are used when transmitting data for radio or television.

.....
..... (1 mark)

2 (b) (ii) Briefly describe **one** technique for compressing a signal.

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..... (1 mark)

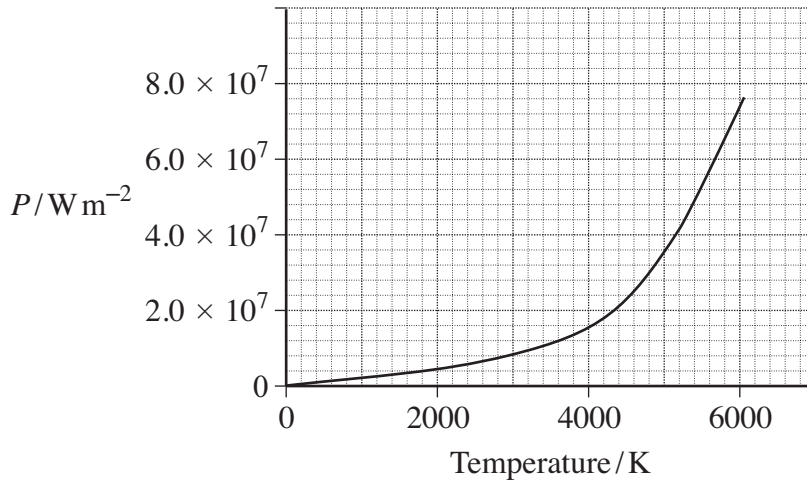
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3 **Figure 2** shows how the power radiated per square metre by a black body varies with temperature.

Figure 2



A star has a radius of 8.0×10^8 m and a surface temperature of 5.2×10^3 K.
Use data from **Figure 2** to calculate the luminosity of the star.
Give your answer to an appropriate number of significant figures.

.....

luminosity W
(4 marks)

4 (i) What is meant by the term *quasar*?

.....
(1 mark)

4 (ii) State **two** characteristics of a quasar.

.....

(2 marks)



- 5 (i) Calculate the critical angle for light travelling from water to air.
refractive index of water = 1.3
refractive index of air = 1.0

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critical angle degrees
(2 marks)

- 5 (ii) Optical fibres used in communications are often *graded index* fibres.
What is meant by graded index?

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(1 mark)

20

Turn over for the next question

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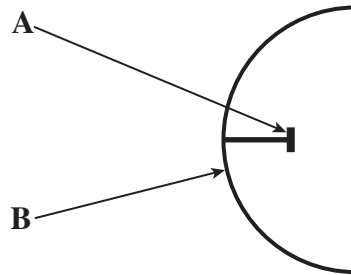
Section B

Answer **all** questions in this section.

There are 50 marks for this section.

6 **Figure 3** shows a satellite's transmission dish.

Figure 3



6 (a) Name the labelled parts of the dish.

A

B

(2 marks)

6 (b) The footprint of a geosynchronous satellite has a diameter of 1200 km. The orbital height of the satellite is 3.7×10^7 m.

6 (b) (i) Show that the diffraction angle, θ , producing this satellite's footprint is approximately 0.9° .

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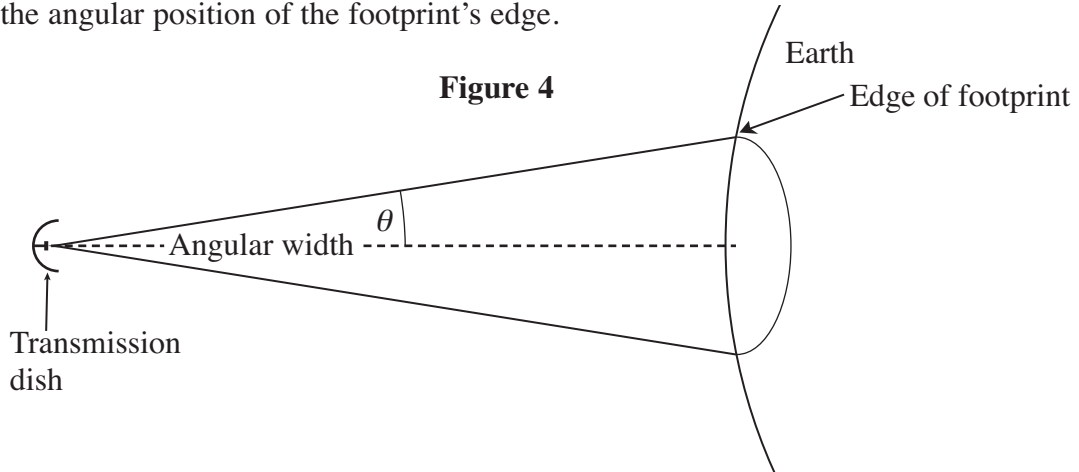
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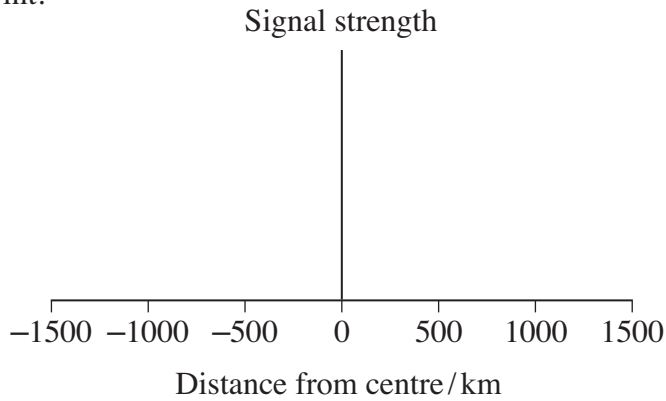
(2 marks)



6 (b) (ii) Figure 4 shows the satellite's footprint where θ , the diffraction angle, corresponds to the angular position of the footprint's edge.



On the axes below, sketch the variation in signal strength with distance from the centre of the footprint.



(3 marks)

6 (b) (iii) The satellite broadcasts radio waves of wavelength 2.4×10^{-2} m. Calculate the diameter of the transmission dish.

diameter m
(3 marks)

6 (b) (iv) State **one** advantage and **one** disadvantage of increasing the diameter of the transmission dish.

Advantage

.....

Disadvantage

.....

(2 marks)



7 (a) (i) A piano string has a tension of 681 N. It vibrates with a fundamental frequency (first harmonic) of 92.5 Hz and has a mass per unit length of $1.87 \times 10^{-2} \text{ kg m}^{-1}$. Calculate the length of the string.

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length of string m
(3 marks)

7 (a) (ii) **Figure 5** shows a string stretched between fixed ends. Draw onto **Figure 5** the first overtone (second harmonic) mode of vibration.

Figure 5



(1 mark)

7 (a) (iii) State how you could make a string on a stringed instrument vibrate in this mode of vibration.

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(2 marks)



7 (b) Describe how you would investigate the variation of the fundamental frequency (first harmonic) of a string with its length.
State which variable(s) you would need to control and how you would do so.
You may wish to assist your account by drawing a diagram.

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(4 marks)

10

Turn over ►



8 (a) State what is seen when Brownian motion is viewed, under a microscope, using smoke in air.
Explain how the observations support the idea of the kinetic theory of gases.

The quality of your written answer will be assessed in this question.

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(6 marks)

8 (b) (i) It is not possible to observe quarks directly.
Describe how it has been shown experimentally that protons are made up of quarks.

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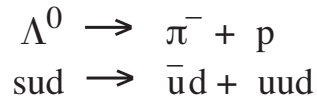
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(2 marks)



- 8 (b) (ii)** The equations below show the decay of a Λ^0 particle and the quark structure of the particles involved.



Use the conservation of charge and baryon numbers to demonstrate that the decay is feasible.

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(2 marks)

- 8 (b) (iii)** The equation below shows that strangeness is not conserved in the decay of a Λ^0 particle.
Comment on why the reaction can happen despite the fact that strangeness is not conserved.

$$(-1)+0+0 \rightarrow 0+0 + 0+0$$

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(2 marks)

12

Turn over for the next question

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9 (a) A hydrogen atom relaxes into its ground state of -13.6 eV . As it does so, it releases a photon of electromagnetic radiation with an energy of 10.2 eV .

9 (a) (i) Calculate the energy level of the atom before it relaxed to the ground state.

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energy level eV
(1 mark)

9 (a) (ii) Show that the photon energy is approximately $1.6 \times 10^{-18}\text{ J}$.

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(1 mark)

9 (a) (iii) Calculate the wavelength of the radiation emitted.

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wavelength m
(3 marks)

9 (a) (iv) State the region of the electromagnetic spectrum to which this radiation belongs.

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(1 mark)



9 (b) Explain what is meant by the absorption spectrum of a star and how it gives useful information to astronomers.

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(3 marks)

9

Turn over for the next question

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10 (a) Explain what is meant by red shift and why it gives evidence for the Big Bang theory.

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(3 marks)

10 (b) (i) Explain what is meant by dark matter.

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(2 marks)

10 (b) (ii) Explain why the study of dark matter is important to the understanding of the fate of the Universe.

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(2 marks)

END OF QUESTIONS

7



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