Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

(a) Explain what is meant by a parsec. Draw a labelled diagram in support of your answer.

_____

_____

_____

(2)

(b) The Hipparcos satellite used the parallax method to measure the distance to more than 100 000 stars with a precision of 0.002 arc seconds.
Calculate, in metres, the maximum distance measurable by Hipparcos.
Give your answer to an appropriate number of significant figures.

distance _____ m

(3)

(c) The star Alpha Capricorni is in fact two stars that appear very close together.
Some data about the two stars are summarised in the following table.

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Star	Distance / pc	Apparent magnitude	Class
Alpha-1 capricorni	211	4.3	G
Alpha-2 capricorni	33	3.6	G

(i) Explain how data in the table indicate that the two stars are **not** part of a binary system.

_____

_____

_____

(1)

(ii) Explain why the angular separation of the two stars changes when observed from the Earth during a 12 month period.

_____

_____

_____

(1)

(Total 7 marks)

Q2.

In an experiment, a set of light emitting diodes LEDs that emitted light of different colours was used. The minimum pd V_{min} for light to be emitted by each diode was measured. The results are given in the table, together with the average wavelength λ of the light emitted by each diode and the corresponding frequencies f for some of the LEDs. Some points are plotted on the graph of V_{min} against f.

colour	wavelength λ/nm	frequency f / 10^{14} Hz	minimum pd V_{min} /V
infrared	940	3.19	0.92
red	665	4.51	1.54
orange	625	4.80	1.54
yellow	595	5.04	1.78
green	565		1.87
blue	470		2.37

(a) Complete the table.

(1)

(b) Complete the graph by plotting the missing two points and drawing a straight line of best fit.

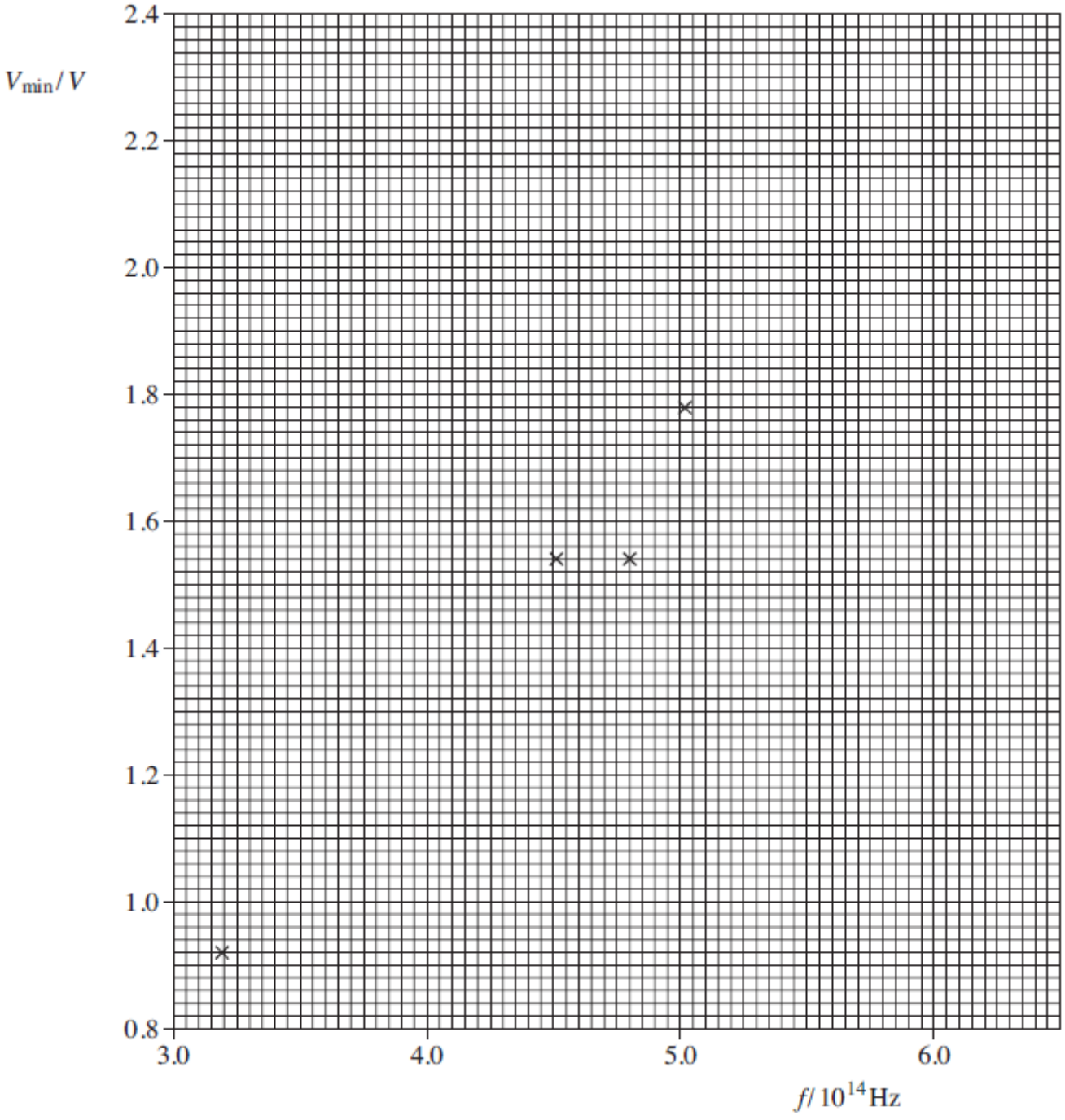
(2)

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(c) (i) Determine the gradient of the graph.

(3)

Graph of minimum pd against frequency



(ii) Discuss the reliability of your value for the gradient.

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(2)

(d) Theory predicts that the energy lost by the electron in passing through the LED is theenergy of the emitted photon. Hence

$$eV_{min} = hf,$$

where h is the Planck constant and $e = 1.60 \times 10^{-19}$ C.

(i) Find a value for h by using the general equation of a straight line, $y = mx + c$, and your answer to part (c)(i).

(3)

(ii) The accepted value for $h = 6.63 \times 10^{-34}$ J s. Calculate the percentage difference between the value calculated in part (d)(i) and the accepted value.

(1)

(iii) The precision of the voltmeter was ± 0.01V. Calculate the percentage uncertainty this produces in the value of V_{min} for the infrared radiation.

(1)

(iv) A student assumes that the percentage difference calculated in part (d)(ii) is due only to the uncertainty in V_{min}, as determined in part (d)(iii), and the uncertainty in the frequency. Using this assumption calculate the uncertainty in the value of the infrared frequency quoted in the table.

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(3)
(Total 16 marks)

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