Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE A Level Physics

Topic 12: Space

Test 1

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

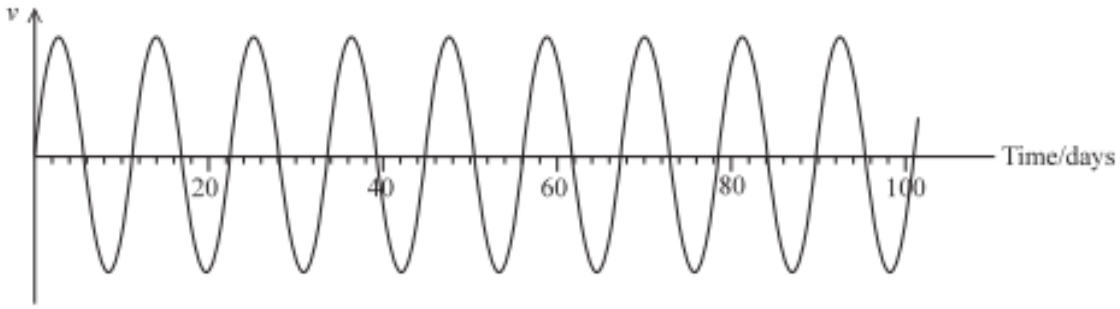
- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1

14 In 2016 astronomers announced the discovery of an Earth-like planet orbiting Proxima Centauri, the closest star to the Sun.

The planet was detected because of the small movement of the star as the planet orbited. The movement was detected using the Doppler shift in the frequency of light travelling to the Earth.

The graph shows how the component of the star's velocity v towards the Earth varied over time.

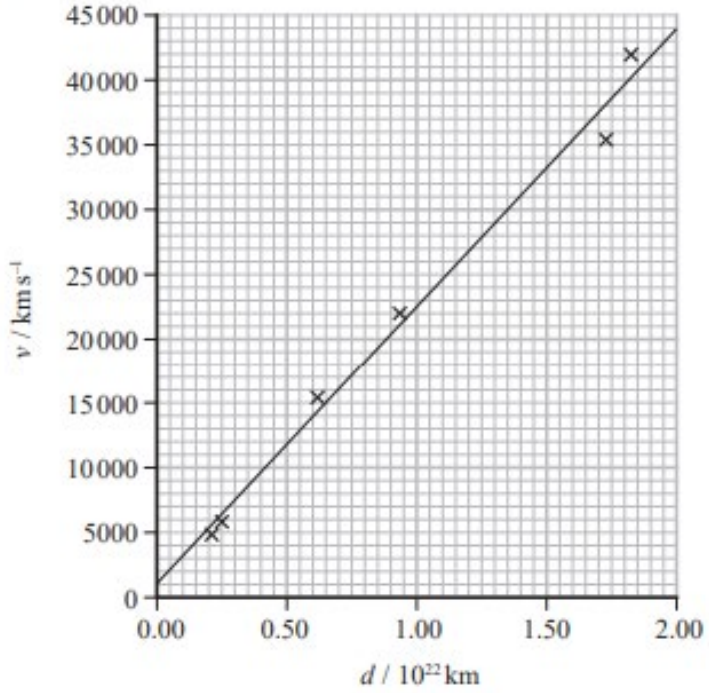


(a) Explain how the Doppler shift was used to obtain the data shown on the graph.

(4)

6 In 1990, the Hubble Space Telescope (HST) was launched into a low Earth orbit above the Earth's atmosphere.

(c) High resolution images from HST allow astronomers to make detailed measurements of very distant galaxies. The graph shows how the recessional velocities of distant galaxies depend on their distance from Earth.



Determine an age for the universe.

(3)

Age for the universe = ...

19 In 2016 the Breakthrough Starshot initiative was announced. This project intends to send a fleet of small probes to Proxima Centauri, the nearest star to the Sun. This journey would take about twenty years.

(a) The radiation intensity at Earth from Proxima Centauri is 3.25×10^{-11} W m^{-2}. The luminosity of the Sun is $L_{\odot}$.

(i) Show that the luminosity of Proxima Centauri is about 0.002 $L_{\odot}$.

(3)

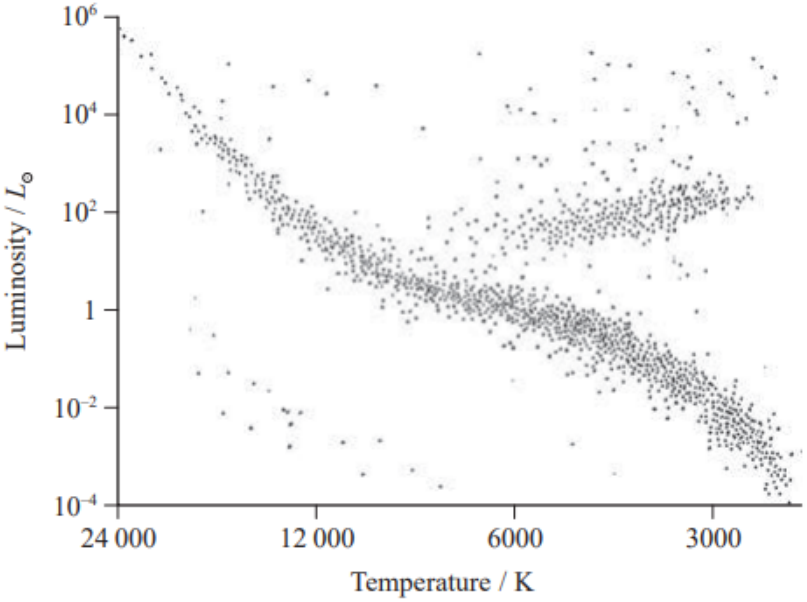
distance to Proxima Centauri = 4.00×10^{16} m
$L_{\odot} = 3.85 \times 10^{26}$ W

(ii) Proxima Centauri is described on a website as a main sequence star.

Determine whether the surface temperature of Proxima Centauri is consistent with a position on the main sequence of the Hertzsprung-Russell diagram.

(3)

radius of Proxima Centauri = 9.81×10^7 m



13 The distance to astronomical objects relatively close to the Sun is determined using trigonometric parallax. For objects beyond a certain distance standard candles are used.

(a) State what is meant by a standard candle.

(1)

(b) Explain why trigonometric parallax is not used beyond a certain distance.

(2)

(c) Describe how distances too large for the use of standard candles can be determined.

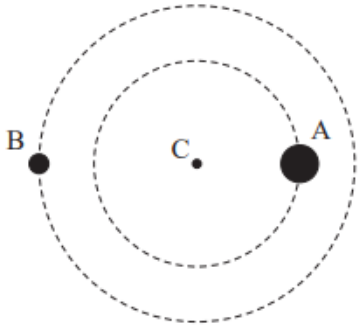
(3)

(Total for Question 13 = 6 marks)

5

12 The diagram shows two black holes, A and B, orbiting each other.

Assume that the centre of mass C of the system is the centre of a circular orbit for each black hole as shown in the diagram.



Black hole A is in an orbit of radius 2.9×10^{10} m and black hole B is in an orbit of radius 3.6×10^{10} m. Both orbit with the same period, so the total distance between them is 6.5×10^{10} m.

(a) Calculate the force between the black holes.

mass of Sun, $M_{\odot} = 1.99 \times 10^{30}$ kg
mass of black hole A = $36M_{\odot}$
mass of black hole B = $29M_{\odot}$

(2)

Force = ...

6

14 The photograph shows a filament bulb.

The filament is an emitter with 35% of the power output of a black body radiator of the same temperature.

(a) When a potential difference (p.d) of 2.0 V is applied across the bulb, there is a current of 0.37 A in the filament.

Calculate the temperature of the filament.

surface area of filament = 3.9×10^{-6} m^2

(3)

Temperature = ...

7

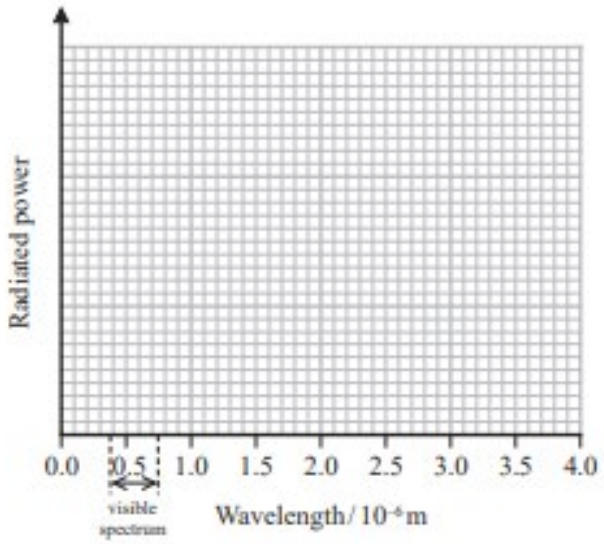
(b) In an experiment to investigate the efficiency of a filament light bulb a p.d. was applied. The p.d. and current were measured and the light bulb was observed. The p.d. was then increased and new measurements taken.

When a small p.d. is applied to the bulb, no light is visible. If the p.d. is gradually increased, the filament starts to glow and eventually appears white.

(i) Add to the graph to show the distribution of radiation from a black body at a temperature of 2026 K.

Your answer should include a calculation.

(5)



(ii) Use your graph to explain why filament light bulbs are considered inefficient.

(2)

(Total for Question 14 = 10 marks)

TOTAL FOR PAPER IS 32 MARKS