Pearson Edexcel International Advanced Level

Thursday 15 January 2026

Morning (Time: 1 hour 45 minutes)

Paper reference **WPH15/01A**

Physics

International Advanced Level

UNIT 5: Thermodynamics, Radiation, Oscillations and Cosmology

Question Paper

You must have:
Scientific calculator and Answer Book (sent separately).
Do not return this question paper with the answer book.

Information

- The list of data, formulae and relationships is printed at the end of this booklet.

Turn over ▶

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Pearson

SECTION A

Answer ALL questions.

For questions 1–10, in Section A, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The brightness of a star depends upon its luminosity and

A core temperature.

B distance from the observer.

C initial mass.

D surface temperature.

(Total for Question 1 = 1 mark)

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2 Two containers are filled with two gases, A and B. The gases have the same temperature, but the mean squared speed of the molecules in B is twice the mean squared speed of the molecules in A.

Which of the following is equal to $\frac{\text{mass of a molecule in B}}{\text{mass of a molecule in A}}$?

A 0.25

B 0.5

C 2

D 4

(Total for Question 2 = 1 mark)

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3 The average density of the universe is unknown. Scientists believe that there is a critical value for this density.

Which of the following describes the future of the Universe if the density of the Universe is more than the critical density?

A It will eventually reach a maximum size.

B It will keep expanding forever.

C It will maintain its present size.

D It will reach a maximum size and then contract.

(Total for Question 3 = 1 mark)

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4 A student used a detector and counter to measure the background radiation count for five minutes. He used this value to calculate the background count rate.

Which of the following would increase the accuracy of the student's value for the background count rate?

A Decrease the counting time to 1 minute.

B Increase the counting time to 10 minutes.

C Repeat the count with a different detector and calculate a mean value.

D Repeat the count in a different location and calculate a mean value.

(Total for Question 4 = 1 mark)

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5 A sample of radioactive material has a known half-life. Radioactive decay is a random process.

Which of the following predictions can be made?

A when a given nucleus will decay

B the time for the whole sample to decay

C the next nucleus that will decay

D the fraction of a sample that will decay in a second

(Total for Question 5 = 1 mark)

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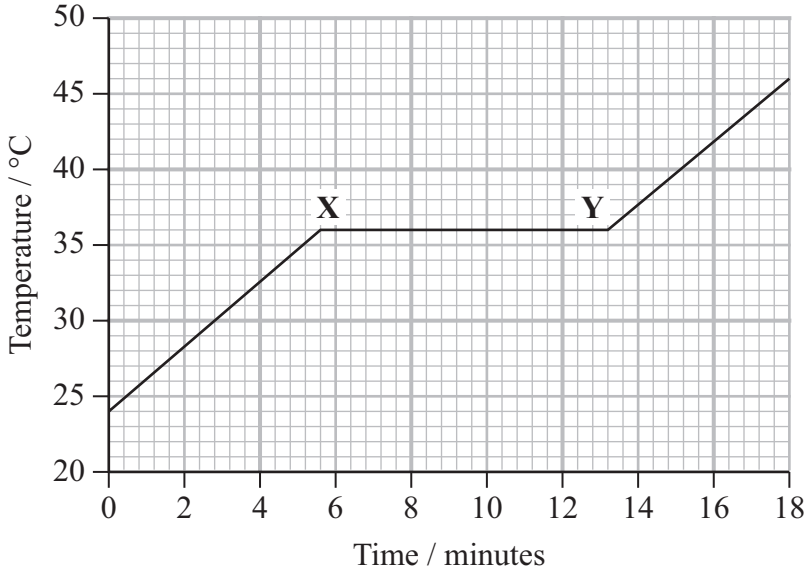
6 A piece of chocolate is heated at a constant rate.

The graph shows how the temperature of the chocolate varies with time.



Select the correct statement for the time between X and Y.

A The internal energy of the chocolate increases.

B The internal energy of the chocolate stays constant.

C The kinetic energy of the molecules in the chocolate increases.

D The potential energy between the molecules in the chocolate stays constant.

(Total for Question 6 = 1 mark)

7 The Hertzsprung–Russell diagrams W, X, Y and Z below show a star cluster at various times when the star cluster is in different stages of evolution.

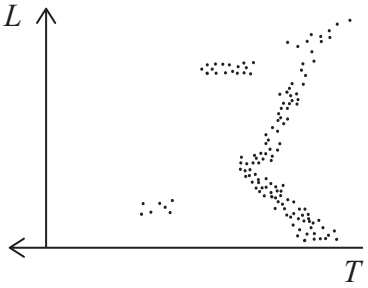


Diagram W

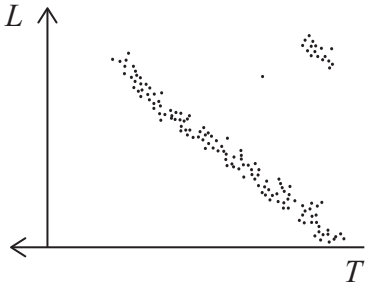


Diagram X

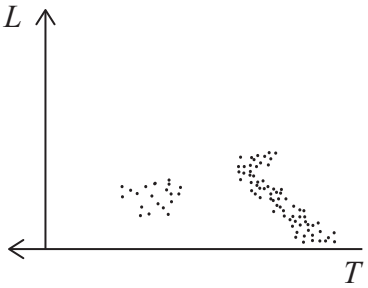


Diagram Y

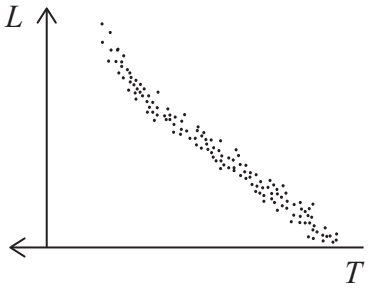


Diagram Z

Which of the diagrams represents the cluster in the final stage of evolution?

A W, as there are white dwarf stars and red giants in the cluster.

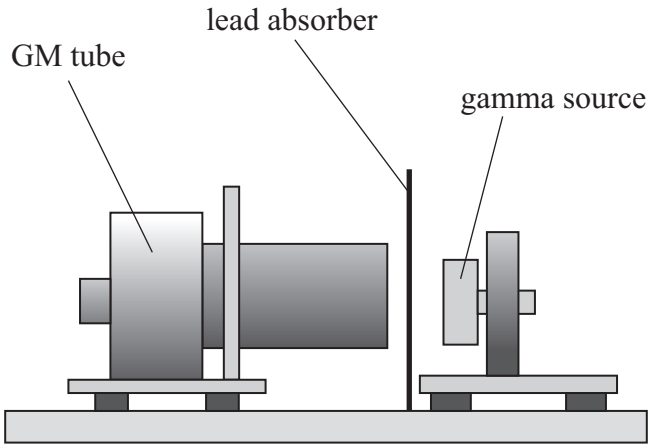
B X, as there are red giants and no white dwarf stars in the cluster.

C Y, as there are white dwarf stars but no red giants in the cluster.

D Z, as all the stars in the cluster are in the main sequence.

(Total for Question 7 = 1 mark)

8 A student investigated the absorption of gamma radiation by lead, as shown.



With no absorber the intensity of radiation was I_O. With an absorber of thickness 3.2 cm the intensity was 0.25 I_O

What thickness of absorber would give an intensity of 0.5 I_O?

A 0.2 cm

B 0.4 cm

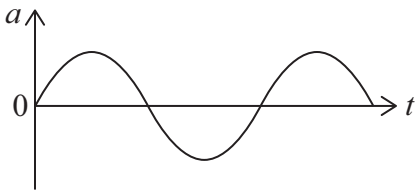
C 1.6 cm

D 3.2 cm

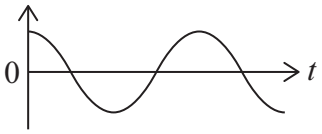
(Total for Question 8 = 1 mark)

Questions 9 and 10 refer to the information below.

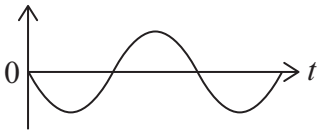
The graph shows how the acceleration a varies with time t for an object undergoing simple harmonic motion.



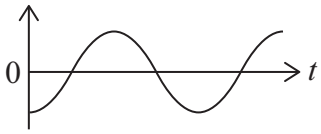
The following graphs show how other quantities for the object may vary over the same time period.



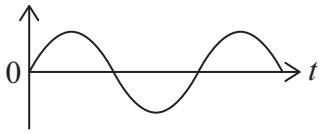
A



B



C



D

9 Which graph shows the variation of displacement with time?

(Total for Question 9 = 1 mark)

10 Which graph shows the variation of velocity with time?

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11 The Earth is 81 times more massive than the Moon. The gravitational field strength at the surface of the Earth is 6 times greater than at the surface of the Moon.

Calculate the mean radius of the Moon.

mean radius of Earth = 6.37×10^{6} m

(Total for Question 11 = 2 marks)

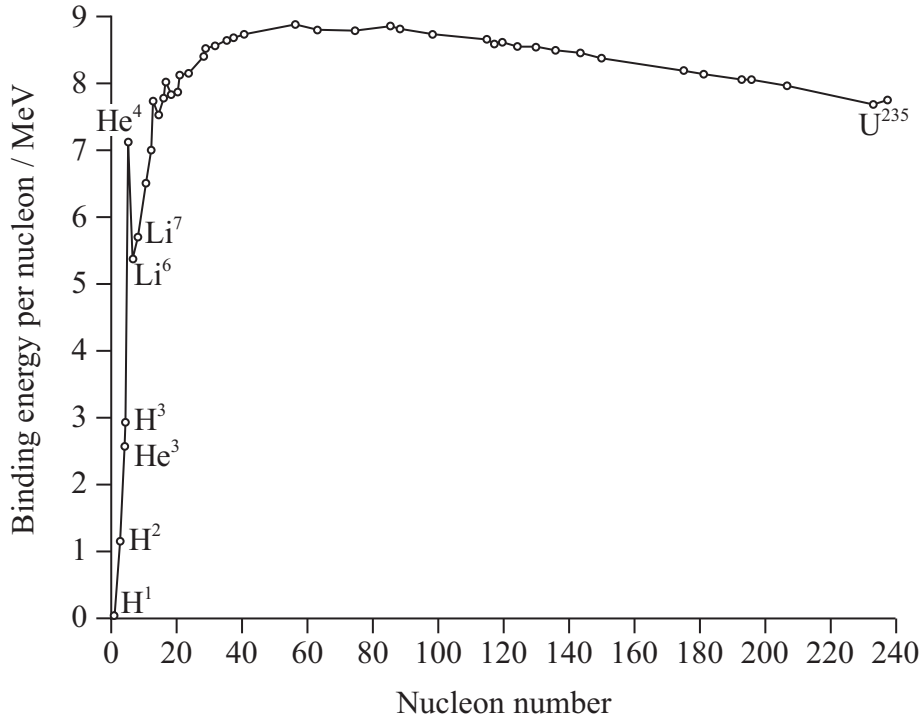
12 Light from either end of the Sun's diameter is analysed and compared to light from the centre of the Sun. A hydrogen line in the light from the centre of the Sun has a wavelength of 490 nm.

The shift in wavelength observed from opposite edges of the Sun's diameter is 3.4×10^{-3} nm.

Calculate the angular velocity of the Sun.
radius of the Sun = 7.0×10^{8} m

(Total for Question 12 = 3 marks)

13 The graph shows how the binding energy per nucleon varies with nucleon number for a range of isotopes.



Explain why fission reactors use isotopes such as U-235 as fuel and why there is still ongoing research to develop fusion reactors.

Your answer should include reference to the graph.

(Total for Question 13 = 4 marks)

14 Cocoa powder, milk and hot water are mixed together to produce a 'hot chocolate' drink. The mass of the drink is 275 g, and its initial temperature is 71.5 °C.

Ice at 0.0 °C is added to the drink to reduce its temperature. Research indicates that the maximum serving temperature of any hot drink should be 58.0 °C.

Deduce whether 4.0 g of ice would be enough to bring the temperature below 58.0 °C.

specific latent heat of ice = 3.34×10^5 J kg^{-1}
specific heat capacity of 'hot chocolate' = 3750 J kg^{-1} °C^{-1}
specific heat capacity of water = 4190 J kg^{-1} °C^{-1}

(Total for Question 14 = 5 marks)

15 A weather balloon takes scientific equipment high into the atmosphere to monitor atmospheric conditions.

A weather balloon is filled with hydrogen at a temperature of 22.5 °C and a pressure of 1.02×10^5 Pa. The volume of the balloon is 7.50 m^3.

The balloon rises through the atmosphere to a maximum height. At the maximum height, the temperature of the hydrogen in the balloon is –48.0 °C and the pressure of the hydrogen in the balloon is 8.40×10^4 Pa.

(a) Calculate the volume of the balloon at the maximum height.

(3)

(b) Calculate the decrease in the mean kinetic energy of a hydrogen molecule in the balloon as the balloon rises to the maximum height.

(2)

(Total for Question 15 = 5 marks)

***16** A ‘scuba tank’ is used to store air at high pressure.

Explain why the pressure of the air inside the scuba tank increases as the temperature increases. Your answer should refer to the motion of the air molecules.

(Total for Question 16 = 6 marks)

17 A commercial drinks dispenser fills a cup with 0.30 kg of water at a temperature of 5.0 °C after chilling it for 2 minutes.

(a) The water enters the dispenser at a temperature of 20 °C.

Calculate the electrical power of the heater in the dispenser.

specific heat capacity of water = 4200 $J\,kg^{-1}\,K^{-1}$

(3)

(b) Suggest why the actual power of the heater may differ from the value calculated in (a).

(2)

(Total for Question 17 = 5 marks)

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18 Superfluid He-3 has been used as a potential dark matter detector. To test the idea, He-3 atoms are bombarded with neutrons.

(a) (i) Deduce the identity of particle X by completing the nuclear equation in the answer booklet.

(3)

$$\underset{\ldots\ldots}{\ldots\ldots}\,n + {}_{2}He \rightarrow {}_{1}H + \underset{\ldots\ldots}{{}^{1}X}$$

(ii) Calculate the total kinetic energy, in MeV, of the reaction products. Assume that the neutron has zero kinetic energy.

	Mass / u
electron	0.000549
proton	1.007276
neutron	1.008665
H-2	2.013553
H-3	3.015501
He-3	3.014932
He-4	4.001506

(3)

(b) Tritium (H-3) is an isotope of hydrogen.

(i) Define what an isotope is.

(2)

(ii) State what is meant by a positron, and suggest why positron emission cannot occur for H-3.

(2)

(c) Tritium has a half-life of 12.5 years.

At a particular instant a sample of tritium contains 3.2×10^{12} atoms.

(i) Calculate the activity of the sample at this instant.

(3)

(ii) Determine the activity of the sample 60 years later.

(3)

(Total for Question 18 = 16 marks)

19 Salyut 1 was the first Earth-orbiting space station. It was built by the Soviet Union and launched into a low Earth orbit fifty years ago.

(a) Salyut 1 orbited at an average height above the surface of the Earth of 211 km.

mass of Salyut 1 = 18 400 kg
mass of Earth = 5.98×10^{24} kg
radius of Earth = 6.37×10^{6} m

(i) A textbook claims that for astronauts in Salyut 1, there would be a sunrise 16 times every day.

Assess the validity of this claim.

1 day = 8.64×10^{4} s

(4)

(ii) Salyut 1 made almost three thousand orbits before falling back to Earth.

Calculate the change in gravitational potential energy of Salyut 1 as it fell back to Earth.

(3)

(b) Salyut 1 burned up over the Pacific Ocean as it re-entered the Earth's atmosphere.

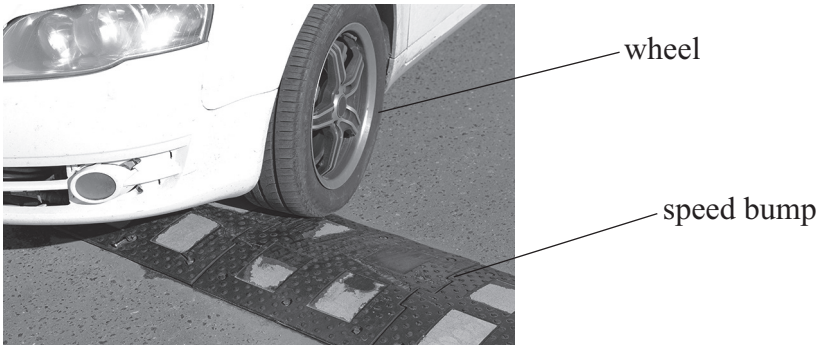
Explain why Salyut 1 burned up.

(2)

(Total for Question 19 = 9 marks)

20 The suspension system of a car is a set of springs that allows the body of the car to move vertically up and down relative to the wheels.

A car is driven along a long straight road that has a series of 'speed bumps'. Speed bumps are raised parts in a road, as shown.



(Source: © Sergey Makarenko/Alamy Stock Photo)

At a particular speed of the car resonance occurs. The amplitude of vibration of the car body on the suspension system becomes much larger.

(a) Explain why the amplitude of vibration increases at a particular speed.

(2)

(b) A car suspension system can be thought of as a mass-spring system. The natural frequency of the system is determined by the force constant of the suspension k and the total mass of the system m.

(i) A car is set into vertical oscillation by applying a momentary downwards force.

Show that the frequency of oscillation f is given by

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

(2)

(ii) A person of mass 75 kg steps into the car, the vertical height of the car above the road decreases by 1.5 cm
The mass of the empty car is 1450 kg.

The car is driven along the road at a speed of 13.4 m s^{-1}
Adjacent speed bumps are a distance of 14.9 m apart.

Deduce whether resonance will occur.
You should consider the car as a mass-spring system.

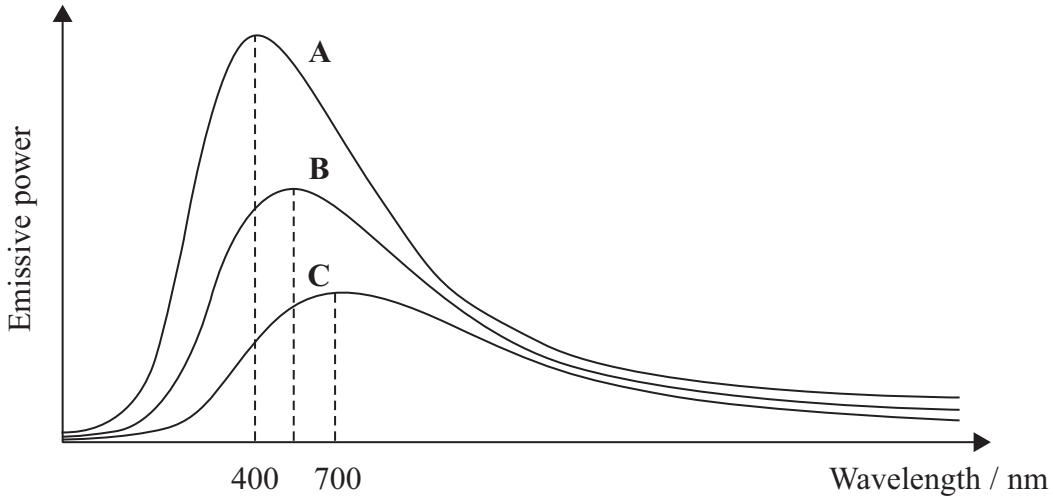
(5)

(c) Explain how damping reduces the large amplitude of vibration of the car on its suspension, and how it could be achieved in practice.

(3)

(Total for Question 20 = 12 marks)

21 Curves A, B and C show the radiation spectra of stars with three different surface temperatures.



(a) Curve B represents radiation from the Sun.

(i) State what evidence from the graphs suggests that this might be so.

(1)

(ii) State, with a reason, which curve represents a star with a lower surface temperature than the Sun.

(1)

(iii) Explain, using the graphs, how the radiation from the star identified in (ii) differs from the radiation from the Sun.

(1)

(iv) Determine, using curve B, the surface temperature of the Sun.

(2)

(Total for Question 21 = 5 marks)

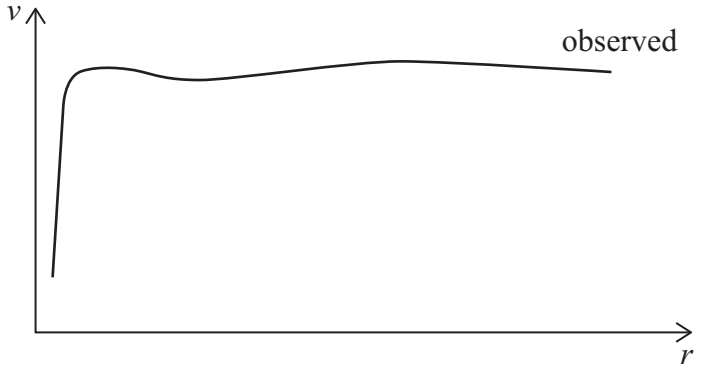
22 Almost fifty years ago, a physicist called Vera Rubin found evidence for the existence of dark matter from her observations of nearby spiral galaxies. Her observations seemed to contradict Newton's laws.

(a) Show that the velocity v of a star of mass m, in an orbit of radius r about a larger mass M, is given by

$$v = \sqrt{\frac{GM}{r}}$$

(2)

(b) Stars orbit the centre of their galaxies. Most of the visible mass of a galaxy is concentrated at its centre. The graph shows how the velocity v of stars varies with distance r from the centre of the galaxy.



(i) Sketch, on the same graph in the Answer Book, how the predicted velocity of stars varies with distance r from the centre of the galaxy. Label it with the word 'predicted'.

(1)

(ii) Explain how dark matter may account for the difference between the observed velocity and the predicted velocity of stars far away from the centre of the galaxy.

You may assume that, for a star orbiting at radius r, all the matter inside the sphere of radius r acts like a point mass at the centre.

(2)

(c) The exact amount of dark matter in the Universe is unknown.

Explain how the amount of dark matter might be expected to determine the ultimate fate of the Universe.

(3)

(Total for Question 22 = 8 marks)

TOTAL FOR SECTION B = 80 MARKS
TOTAL FOR PAPER = 90 MARKS

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81\ \text{m s}^{-2}$	(close to Earth's surface)
Boltzmann constant	$k = 1.38 \times 10^{-23}\ \text{J K}^{-1}$	
Coulomb's law constant	$k = 1/4\pi\varepsilon_0$	
	$= 8.99 \times 10^{9}\ \text{N m}^2\ \text{C}^{-2}$	
Electron charge	$e = -1.60 \times 10^{-19}\ \text{C}$	
Electron mass	$m_e = 9.11 \times 10^{-31}\ \text{kg}$	
Electronvolt	$1\ \text{eV} = 1.60 \times 10^{-19}\ \text{J}$	
Gravitational constant	$G = 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$	
Gravitational field strength	$g = 9.81\ \text{N kg}^{-1}$	(close to Earth's surface)
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ \text{F m}^{-1}$	
Planck constant	$h = 6.63 \times 10^{-34}\ \text{J s}$	
Proton mass	$m_p = 1.67 \times 10^{-27}\ \text{kg}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$	
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8}\ \text{W m}^{-2}\ \text{K}^{-4}$	
Unified atomic mass unit	$u = 1.66 \times 10^{-27}\ \text{kg}$	

Unit 1

Mechanics

Kinematic equations of motion

$$s = \frac{(u + v)t}{2}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

Momentum

$$p = mv$$

Moment of force

$$\text{moment} = Fx$$

Work and energy

$$\Delta W = F\Delta s$$

$$E_k = \frac{1}{2}mv^2$$

$$\Delta E_{grav} = mg\Delta h$$

Power

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

Efficiency

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

Materials

Density $\rho = \frac{m}{V}$

Stokes' law $F = 6\pi\eta rv$

Hooke's law $\Delta F = k\Delta x$

Elastic strain energy $\Delta E_{el} = \frac{1}{2} F\Delta x$

Young modulus $E = \frac{\sigma}{\varepsilon}$ where

Stress $\sigma = \frac{F}{A}$

Strain $\varepsilon = \frac{\Delta x}{x}$

Unit 2

Waves

Wave speed	$v = f\lambda$
Speed of a transverse wave on a string	$v = \sqrt{\frac{T}{\mu}}$
Intensity of radiation	$I = \frac{P}{A}$
Refractive index	$n_1 \sin\theta_1 = n_2 \sin\theta_2$
	$n = \frac{c}{v}$
Critical angle	$\sin C = \frac{1}{n}$
Diffraction grating	$n\lambda = d \sin\theta$

Electricity

Potential difference	$V = \frac{W}{Q}$
Resistance	$R = \frac{V}{I}$
Electrical power, energy	$P = VI$
	$P = I^2R$
	$P = \frac{V^2}{R}$
	$W = VIt$
Resistivity	$R = \frac{\rho l}{A}$
Current	$I = \frac{\Delta Q}{\Delta t}$
	$I = nqvA$
Resistors in series	$R = R_1 + R_2 + R_3$
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Particle nature of light

Photon model	$E = hf$
Einstein's photoelectric equation	$hf = \phi + \frac{1}{2} mv^2_{max}$
de Broglie wavelength	$\lambda = \frac{h}{p}$

Unit 4

Mechanics

Impulse	$F\Delta t = \Delta p$
Kinetic energy of a non-relativistic particle	$E_k = \frac{p^2}{2m}$
motion in a circle	$v = \omega r$
	$T = \frac{2\pi}{\omega}$
	$a = \frac{v^2}{r}$
	$a = r\omega^2$
Centripetal force	$F = ma = \frac{mv^2}{r}$
	$F = mr\omega^2$

Electric and magnetic fields

Electric field	$E = \frac{F}{Q}$
Coulomb's law	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$
	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$
	$E = \frac{V}{d}$
Electrical potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
Capacitance	$C = \frac{Q}{V}$
Energy stored in capacitor	$W = \frac{1}{2}QV$
	$W = \frac{1}{2}CV^2$
	$W = \frac{1}{2}\frac{Q^2}{C}$
Capacitor discharge	$Q = Q_0 e^{-t/RC}$

Resistor-capacitor discharge $I = I_0 e^{-t/RC}$

$V = V_0 e^{-t/RC}$

$\ln Q = \ln Q_0 - \frac{t}{RC}$

$\ln I = \ln I_0 - \frac{t}{RC}$

$\ln V = \ln V_0 - \frac{t}{RC}$

In a magnetic field $F = Bqv \sin \theta$

$F = BIl \sin \theta$

Faraday's and Lenz's laws $\mathscr{E} = \frac{-\mathrm{d}(N\phi)}{\mathrm{d}t}$

Nuclear and particle physics

In a magnetic field $r = \frac{p}{BQ}$

Mass-energy $\Delta E = c^2 \Delta m$

Unit 5

Thermodynamics

Heating

$$\Delta E = mc\Delta\theta$$

$$\Delta E = L\Delta m$$

Ideal gas equation

$$pV = NkT$$

Molecular kinetic theory

$$\tfrac{1}{2}m\langle c^2\rangle = \tfrac{3}{2}kT$$

Nuclear decay

Mass-energy

$$\Delta E = c^2\Delta m$$

Radioactive decay

$$A = -\lambda N$$

$$\frac{\mathrm{d}N}{\mathrm{d}t} = -\lambda N$$

$$\lambda = \frac{\ln 2}{t_{1/2}}$$

$$N = N_0 \mathrm{e}^{-\lambda t}$$

$$A = A_0 \mathrm{e}^{-\lambda t}$$

Oscillations

Simple harmonic motion

$$F = -kx$$

$$a = -\omega^2 x$$

$$x = A\cos\omega t$$

$$v = -A\omega\sin\omega t$$

$$a = -A\omega^2\cos\omega t$$

$$T = \frac{1}{f} = \frac{2\pi}{\omega}$$

$$\omega = 2\pi f$$

Simple harmonic oscillator

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Gravitational field strength	$g = \frac{F}{m}$
Gravitational force	$F = \frac{Gm_1m_2}{r^2}$
Gravitational field	$g = \frac{Gm}{r^2}$
Gravitational potential	$V_{grav} = \frac{-Gm}{r}$
Stephan-Boltzman law	$L = \sigma AT^4$
Wein's law	$\lambda_{max}T = 2.898 \times 10^{-3}\,\text{m K}$
Intensity of radiation	$I = \frac{L}{4\pi d^2}$
Redshift of electromagnetic radiation	$z = \frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$
Cosmological expansion	$v = H_0 d$

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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 15 January 2026

Morning (Time: 1 hour 45 minutes)

Paper reference **WPH15/01A**

Physics

International Advanced Level

UNIT 5: Thermodynamics, Radiation, Oscillations and Cosmology

Answer Book

You must have:
Scientific calculator and question paper (sent separately).

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Show all your working out** in calculations and **include units** where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In the question marked with an **asterisk (*)**, marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- The list of data, formulae and relationships is printed at the end of the question paper.

Advice

- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P87610RA

C:1/1/1/1

P 8 7 6 1 0 R A 0 1 2 0

Pearson

SECTION A

Answer ALL questions.

For questions 1–10, in Section A, select one answer from A to D and put a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 1 = 1 mark)

2

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 2 = 1 mark)

3

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 3 = 1 mark)

4

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 4 = 1 mark)

5

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 5 = 1 mark)

6

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 6 = 1 mark)

7

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 7 = 1 mark)

8

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 8 = 1 mark)

9

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 9 = 1 mark)

10

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 10 = 1 mark)

TOTAL FOR SECTION A = 10 MARKS

SECTION B

Answer ALL questions in the spaces provided.

11

Mean radius of the Moon = ...

(Total for Question 11 = 2 marks)

12

Angular velocity of Sun = ...

(Total for Question 12 = 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

13

(Total for Question 13 = 4 marks)

14

(Total for Question 14 = 5 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

15

(a)

(3)

Volume of balloon = ...

(b)

(2)

Decrease in mean kinetic energy = ...

(Total for Question 15 = 5 marks)

***16**

(Total for Question 16 = 6 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

17

(a)

(3)

Electrical power of the heater = ...

(b)

(2)

(Total for Question 17 = 5 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

18

(a) (i)

(3)

$$\_\_\_\_ n + \_\_\_\_ {}_2He \rightarrow \_\_\_\_ {}_1H + \_\_\_\_ {}^1X$$

X = ...

(ii)

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Total kinetic energy of the reaction products = ...

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) (i)

(2)

(ii)

(2)

(c) (i)

(3)

Activity of the sample = ...

(ii)

(3)

Activity of sample 60 years later = ...

(Total for Question 18 = 16 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

19

(a)

(i)

(4)

(ii)

(3)

Change in gravitational potential energy = ...

(b)

(2)

(Total for Question 19 = 9 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

20

(a)

(2)

(b)

(i)

(2)

(ii)

(5)

(c)

(3)

(Total for Question 20 = 12 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

21

(i)

(1)

.....

.....

.....

(ii)

(1)

.....

.....

(iii)

(1)

.....

.....

(iv)

(2)

.....

.....

.....

.....

Surface temperature of the Sun = ...

(Total for Question 21 = 5 marks)

22

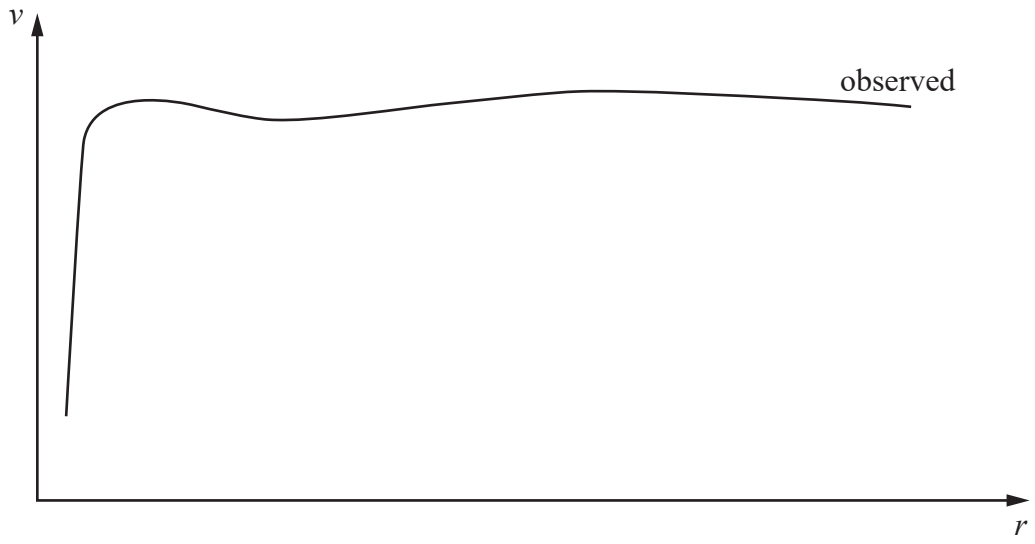
(a)

(2)

(b)

(i)

(1)



(ii)

(2)

(c)

(3)

(Total for Question 22 = 8 marks)

TOTAL FOR SECTION B = 80 MARKS
TOTAL FOR PAPER = 90 MARKS

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