Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Wednesday 10 June 2026

Morning (Time: 1 hour 20 minutes) | **Paper reference** **WPH16/01**

Physics

International Advanced Level
UNIT 6: Practical Skills in Physics II

You must have:
Scientific calculator, ruler

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 50.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- The list of data, formulae and relationships is printed at the end of this booklet.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

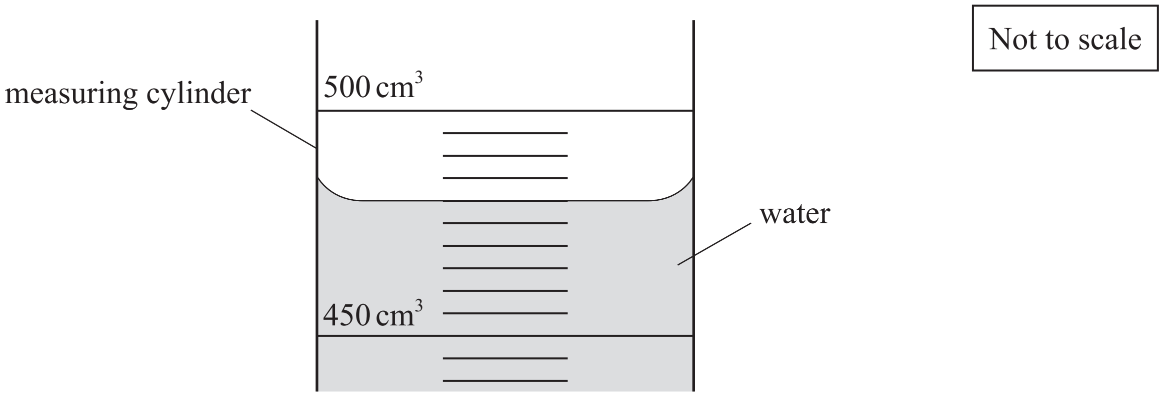
Answer ALL questions.

1 A student investigated standing waves in air. The air was inside a plastic bottle.

(a) The student determined the volume of air in the empty plastic bottle.

The student filled the plastic bottle with water. She poured the water from the plastic bottle into a 500 cm^3 measuring cylinder and measured the volume of water.

The diagram shows the level of water in the measuring cylinder.



(i) State the resolution of this measuring cylinder.

(1)

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(ii) Determine the percentage uncertainty in the measured volume of the water.

(2)

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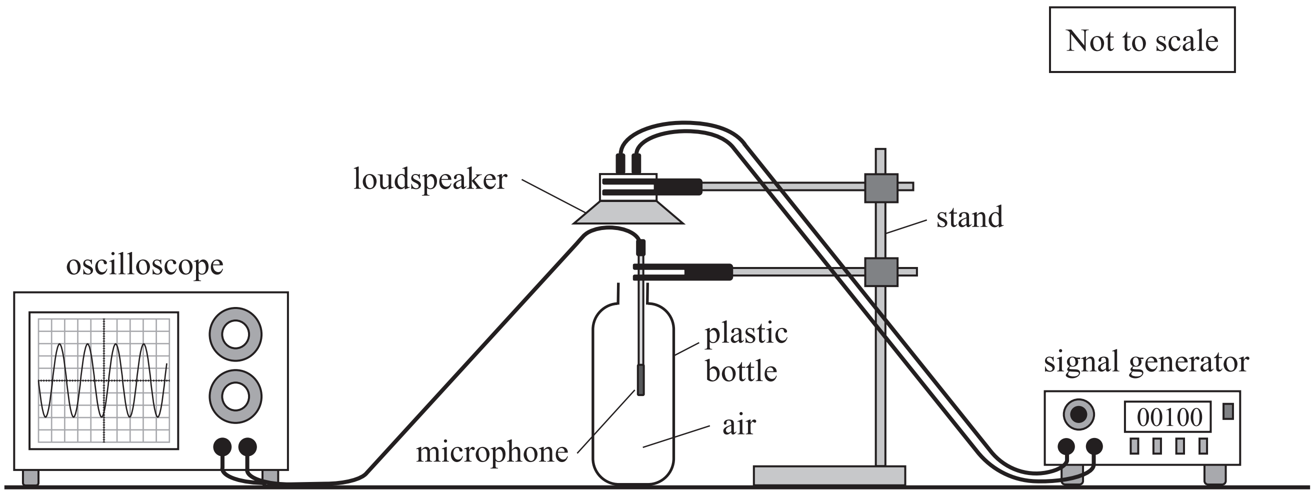
percentage uncertainty = ...

(b) The student used the apparatus shown.

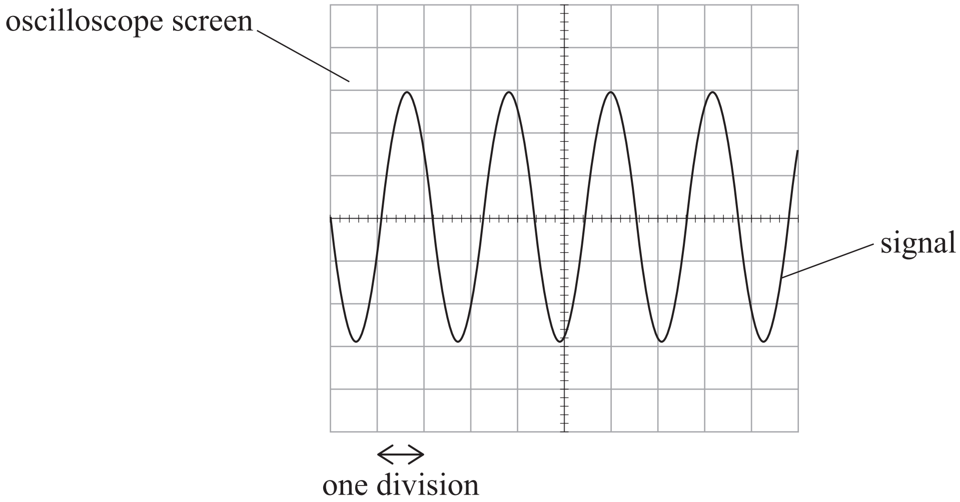


The student switched on the signal generator so that the loudspeaker made a quiet sound. The microphone detected the sound wave inside the plastic bottle.

The student adjusted the signal generator to vary the frequency of the sound.

As the frequency varied, the amplitude of the signal produced by the microphone increased.

The amplitude reached a maximum value at a particular frequency, as shown on the oscilloscope screen.



The horizontal scale was set to 2.0 ms per division.

Show that the frequency of the signal is about 200 Hz.

(4)

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(c) The student changed the volume V of air in the bottle by adding water to the bottle.

The student adjusted the signal generator until the signal from the microphone had a maximum amplitude. She determined the frequency f of the signal.

The student determined f at different values of V and recorded the following results.

V / cm^3	f / Hz
425	260
375	277
330	296

The relationship between f and V is

$$f = kV^{-0.5}$$

where k is a constant.

The student plotted a graph of f against $V^{-0.5}$ and used the gradient to determine a value for k.

Explain why the student's results may **not** give an accurate value for k.

(4)

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(Total for Question 1 = 11 marks)

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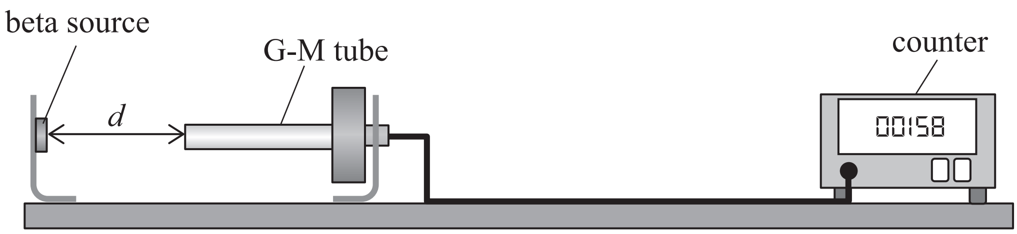
2 A student investigated the range of beta particles in air using the apparatus shown.

Not to scale



The student placed the beta source at a distance *d* from the G-M tube.

(a) Describe **two** safety precautions the student should take when using a beta source.

(2)

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(b) The student predicted that the count rate C would vary with d as

$$C = \frac{a}{d^2}$$

where a is a constant.

Devise a plan the student could use to test his prediction.

You should include the use of a suitable graph.

(6)

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(Total for Question 2 = 8 marks)

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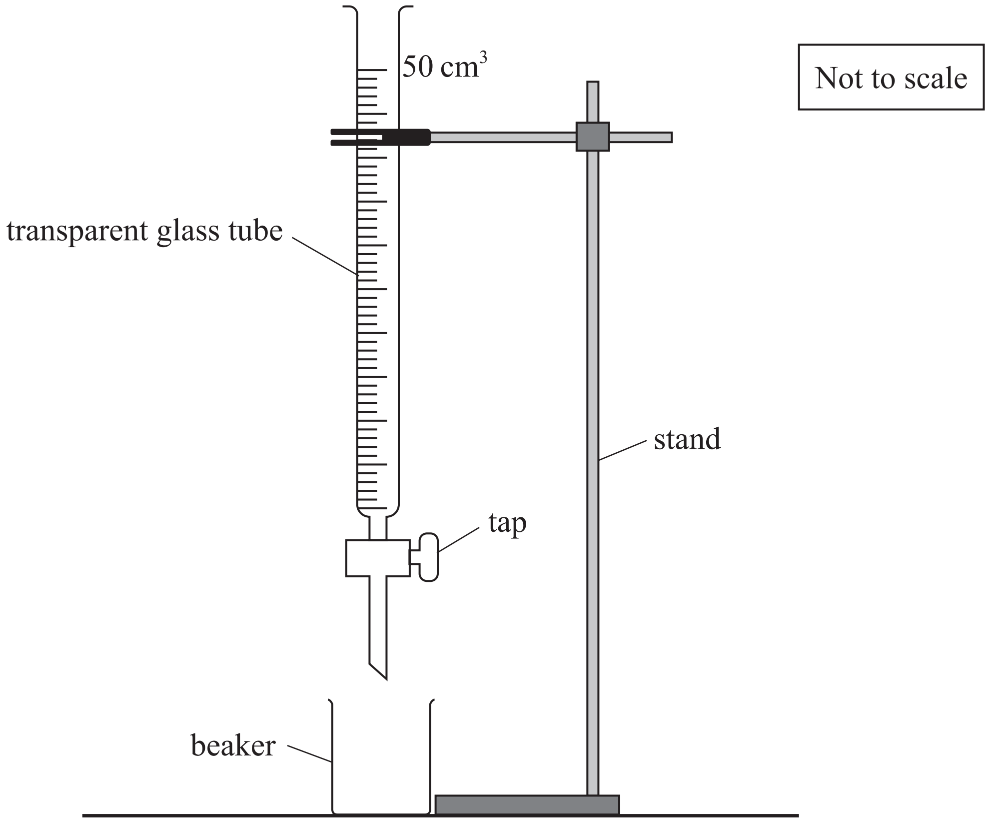
3 A student investigated the flow of liquid glycerol from a transparent glass tube using the apparatus shown.



The student filled the glass tube with glycerol and then opened the tap.

She measured how the volume of glycerol in the glass tube varied with time.

(a) The student filled the glass tube with more than $50\,cm^3$ of glycerol.

The student then opened the tap. She started a stopwatch when the volume of glycerol reached the $50\,cm^3$ mark.

State one advantage of filling the glass tube with more than $50\,cm^3$ of glycerol.

(1)

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(b) The relationship between the volume V of glycerol in the glass tube and the time t is

$$V = 50e^{-bt}$$

where b is a constant.

(i) Explain how a graph of ln V against t can be used to determine a value for b.

(2)

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(ii) The student recorded the following results.

V / cm^3	**t / s**	
45.0	8.65	
35.0	21.73	
25.0	38.91	
15.0	67.85	
5.0	129.11	

Plot a graph of ln V against t on the grid opposite.

Use the additional column to record your processed data.
You should keep the values of V in cm^3.

(5)

(iii) Determine the value of b from the graph.

(3)

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b = ...

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(iv) Explain how using glycerol at a higher temperature would affect the graph.

(3)

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(Total for Question 3 = 14 marks)

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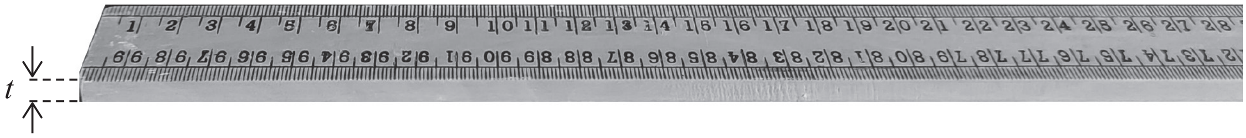
4 A student has a wooden metre rule. The metre rule has thickness t, as shown.



(a) The student used a micrometer screw gauge to measure t at different places along the metre rule. He did not overtighten the micrometer when taking readings.

The student calculated a mean value for t.

Explain one other technique to improve accuracy when using the micrometer.

(2)

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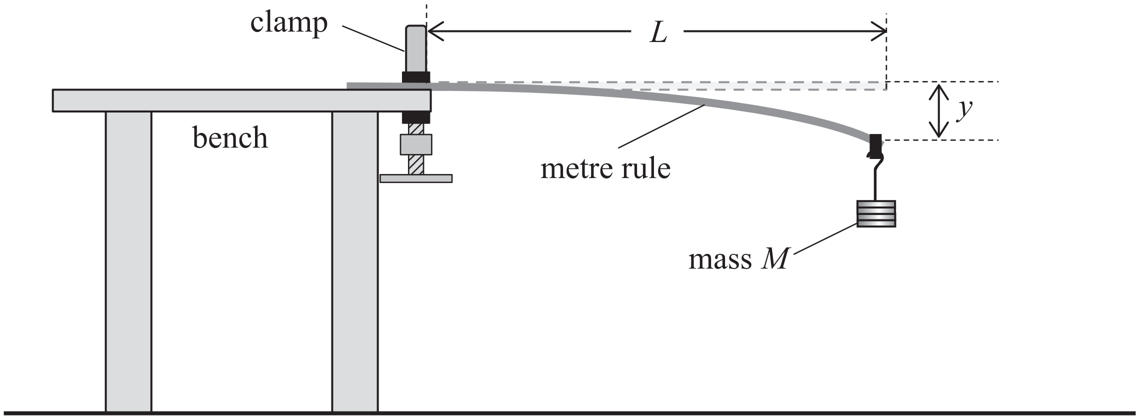
(b) The student clamped the metre rule to a bench. He attached a mass M at a distance L from the clamp, as shown.



The end of the metre rule moved downwards a distance y from its initial position.

(i) Describe a method to determine an accurate value for y using another metre rule.

(3)

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(ii) The student recorded that y was 85 mm ± 1 mm.

Explain why it was appropriate to record an uncertainty of 1 mm for y.

(3)

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(c) The Young modulus E of the wood is given by the formula

$$E = \frac{4MgL^3}{wt^3y}$$

where w is the width of the metre rule.

The student determined that the mass M was 0.3982 kg with negligible uncertainty. He measured w at four different places on the metre rule and recorded the following data.

w / mm	25.07	24.97	25.04	25.01

$L = 0.798\,\text{m} \pm 0.001\,\text{m}$
$t = 6.17\,\text{mm} \pm 0.02\,\text{mm}$
$y = 85\,\text{mm} \pm 1\,\text{mm}$

(i) Show that E is about 1.6×10^{10} Pa.

(3)

(ii) Show that the percentage uncertainty in E is about 3%.

(4)

(iii) The value of E for oak wood is 1.23×10^{10} Pa.

Deduce whether the wooden metre rule could be made from oak.

(2)

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(Total for Question 4 = 17 marks)

TOTAL FOR PAPER = 50 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

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

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

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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 $\rho = \dfrac{m}{V}$

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

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

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

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

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

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

Unit 2

Waves

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

Electricity

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

Particle nature of light

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

Unit 4

Mechanics

Impulse $F\Delta t = \Delta p$

Kinetic energy of a non-relativistic particle $E_k = \dfrac{p^2}{2m}$

motion in a circle $v = \omega r$

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

$$a = \frac{v^2}{r}$$

$$a = r\omega^2$$

Centripetal force $F = ma = \dfrac{mv^2}{r}$

$$F = mr\omega^2$$

Electric and magnetic fields

Electric field $E = \dfrac{F}{Q}$

Coulomb's law $F = \dfrac{Q_1Q_2}{4\pi\varepsilon_0 r^2}$

$$E = \frac{Q}{4\pi\varepsilon_0 r^2}$$

$$E = \frac{V}{d}$$

Electrical potential $V = \dfrac{Q}{4\pi\varepsilon_0 r}$

Capacitance $C = \dfrac{Q}{V}$

Energy stored in capacitor $W = \dfrac{1}{2}QV$

$$W = \frac{1}{2}CV^2$$

$$W = \frac{1}{2}\frac{Q^2}{C}$$

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 $\mathscr{E} = \dfrac{-\mathrm{d}(N\phi)}{\mathrm{d}t}$

Nuclear and particle physics

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

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	$\frac{1}{2}m<c^2> = \frac{3}{2}kT$

Nuclear decay

Mass-energy	$\Delta E = c^2\Delta m$
Radioactive decay	$A = \lambda N$
	$\frac{dN}{dt} = -\lambda N$
	$\lambda = \frac{\ln 2}{t_{1/2}}$
	$N = N_0 e^{-\lambda t}$
	$A = A_0 e^{-\lambda t}$

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

Astrophysics and Cosmology

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

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