A-level Physics

Year 11 into year 12 summer independent work

Deadline – first lesson in September 2025

Welcome to A-level Physics!

The summer independent work is an opportunity for you to review and showcase the skills needed to succeed in A-level Physics.

Evidence needed for the first lesson in September: electronic document, print-out or work on paper showing **all the solutions** Each section should be **clearly labelled**.

Skills review tasks.

Task 1 – Using and rearranging equations:
https://www.youtube.com/watch?v=Ur4ARbm3ark

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A1 on page 5.

Task 2 – Standard form and prefixes:
https://www.youtube.com/watch?v=I1CphggAn20

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A3 on page 6.

Task 3 – Converting units:
https://www.youtube.com/watch?v=4ubobAT-qr0

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A4 on page 7.

Task 4 – Derived and base SI units:

https://www.youtube.com/watch?v=Pr93fElWG3Y&t=5s

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A2 on page 8.

Task 5 – Gradients and intercepts of graphs:
https://www.youtube.com/watch?v=URbw8hNgOx0

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A5 on page 9.

Task 6 – Equations of graphs:
https://www.youtube.com/watch?v=GgR13LG2wbs

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A6 on page 10.

Task 7 – Area under the line on a graph:
https://www.youtube.com/watch?v=ATH25gKXe7o

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A7 on page 11.
3. Go to the questions section at the end of these tasks and answer questions A8 on page 12.

Task 8 – Factor changes
https://www.youtube.com/watch?v=k1vE4NL81o4&t=1s

1. Watch the introductory video

2. Go to the questions section at the end of these tasks and answer questions A9 on page 13.

Task 9 – Proportionality
https://www.youtube.com/watch?v=-u22yJAQDnQ&t=1s

1. Watch the introductory video
2. Go to the questions section at the end of these tasks and answer questions A10 on page 14.

Task 10 – Trigonometry and Pythagoras.

1. Open this link to the trigonometry questions and answer these: https://corbettmaths.com/wp-content/uploads/2013/02/trigonometrypdf1.pdf

2. Open this link to the Pythagoras questions and answer these:
3. https://corbettmaths.com/wp-content/uploads/2013/02/pythagoraspdf2.pdf
4.

If you can't remember much about this, use the links to the videos on the worksheets:

Wider research.

One of the skills you will have to develop over the next 2 years is research. If you get stuck with something, there is a load of information online that can help you, if you know what to do with the info and where to find it.

To help you with this:

Task 11:

1. Go to Minute Physics: https://www.youtube.com/@MinutePhysics/featured

2. Select 3 questions that interest you which have clips above 2 minutes long.

3. Watch them and write a summary to answer each question.

Finally…

Prepare for your first lesson!

Bring with you all the normal equipment below to the first lesson in September:

1. A couple pf pens
2. A couple of pencils
3. A 30 cm ruler (a clear one is best)
4. A protractor
5. A scientific calculator – the one you used for your GCSE maths exams will be perfect
6. A lever arch file – these are the big ones (picture below)

Have a great summer and see you in September…

Questions

A1 Using and Rearranging Equations

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Use the following equations:

$$s = ut \qquad a = \frac{(v-u)}{t} \qquad F = ma \qquad v = f\lambda$$
$$V = IR \qquad P = IV \qquad E = Pt \qquad Q = It$$

where the letters have the following meanings:

s = distance	u, v = velocity	t = time	m = mass
V = voltage	I = current	F = force	a = acceleration
Q = charge	E = energy	P = power	f = frequency
λ = wavelength	R = resistance		

A1.1 a) $F = 3.0$ N, $m = 2.0$ kg, what is a?

b) $I = 0.20$ A, $t = 200$ s, what is Q?

A1.2 Calculate the resistance needed if you want 0.030 A to flow through a component when a 9.0 V battery is connected to it.

A1.3 Calculate the distance travelled by a car going at 30 m s^{-1} in 2.0 minutes.

A1.4 Calculate the wavelength of a wave that travels at 3.0×10^8 m s^{-1} if its frequency is 2.0 GHz (2.0×10^9 Hz).

A1.5 a) Calculate the power of a 0.25 A, 240 V light bulb.

b) Calculate the power if 5.0 A flows through a 2.0 Ω resistor.

A1.6 A Corsa accelerates from 15 m s^{-1} to 25 m s^{-1} in 8.0 s. Calculate the acceleration.

A1.7 If a jet has a maximum acceleration of 20 m s^{-2}, what is the time it would take to get from 0 m s^{-1} to 100 m s^{-1}?

A1.8 My kettle needs to be able to give 672 000 J of heat energy to water in 240 s. Assuming that it is connected to the 240 V mains, what current is needed?

A1.9 Calculate the force needed if my 750 kg car needs to accelerate from rest to 13 m s^{-1} in 5.0 s.

A1.10 Calculate the electrical energy used by a 240 V light bulb with a resistance of 60 Ω in 600 s.

A3 Standard Form and Prefixes

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You will be penalized if you give the wrong number of significant figures where the question specifies the required number of significant figures. [NOTE: standard form means that there is always one non-zero digit before the decimal point.]

A3.1 Write the following as 'normal' numbers:

a) 3×10^{4} b) 4.89×10^{6}

A3.2 Write the following as 'normal' numbers:

a) 3.21×10^{-3} b) 2×10^{0}

A3.3 Write the following in standard form to three significant figures:

a) 2 000 000 b) 34 580

A3.4 Write the following in standard form to three significant figures:

a) 23.914 b) 0.000 005 638

A3.5 Write the following as 'normal' numbers with the unit (but without the prefix):

a) 3 kJ b) 20 mA

A3.6 Write the following using the most appropriate prefixes:

a) 5×10^{7} m b) 6×10^{-10} s

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A4 Converting Units

Convert between units as specified. Express your answer in standard form if the power of ten is ≥ 3, or ≤ -3. Your answer must include units, as indeed it must in *all* questions with units in this book.

Convert:

A4.1 a) 34.5 mm to nm b) 34.5 mm to pm

A4.2 2.4 ps to ms

A4.3 a) 465 μA to mA b) 465 μA to kA

A4.4 43×10^{-7} GW to μW

A4.5 34 m^2 to cm^2

A4.6 58 N m to N cm

A4.7 9600 μm^2 to cm^2

A4.8 0.035 N cm^{-2} to Pa

A4.9 450 kg m^{-3} to kg mm^{-3}

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A2 Derived and Base SI Units

Express the following derived units in terms of the SI base units. The first one has been done for you:

	Derived Unit	in Base Units	Power of each base unit			
			m	s	kg	A
	$m\ s^{-2}$	$m\ s^{-2}$	1	-2	0	0
A2.1	J		(a)	(b)	(c)	(d)
A2.2	N		(a)	(b)	(c)	(d)
A2.3	C		(a)	(b)	(c)	(d)
A2.4	V		(a)	(b)	(c)	(d)
A2.5	Ω		(a)	(b)	(c)	(d)
A2.6	Pa		(a)	(b)	(c)	(d)
A2.7	$N\ C^{-1}$		(a)	(b)	(c)	(d)
A2.8	$V\ m^{-1}$		(a)	(b)	(c)	(d)

Express the following derived units in terms of the unit specified and base units. The first one has been done for you.

A2.9 a) Express the ohm in terms of the volt and base units: $\Omega = V\ A^{-1}$

b) Express the joule in terms of the newton and base unit(s).

c) Express the pascal in terms of the joule and base unit(s).

d) The answer to (c) means that pressure in effect measures an amount of energy per unit _____

e) Express the $V\ m^{-1}$ in terms of the joule and base unit(s).

f) Express the unit of density in newtons and base unit(s).

A5 Gradients and Intercepts of Graphs

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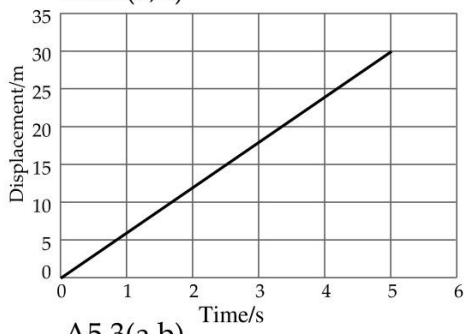
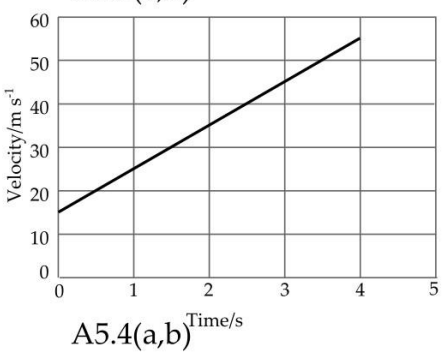
Work out the physical quantity corresponding to the gradient and y-intercept.

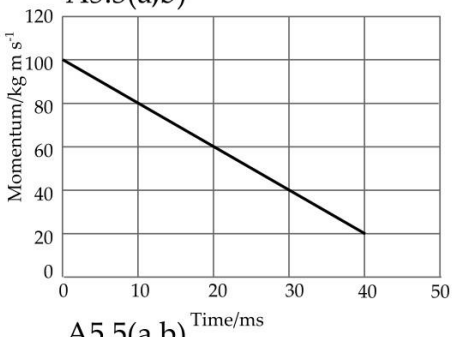
A5.1(a,b)



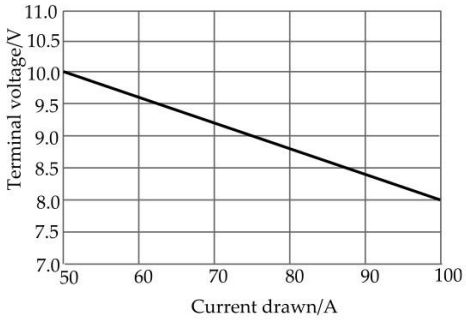
A5.2(a,b)



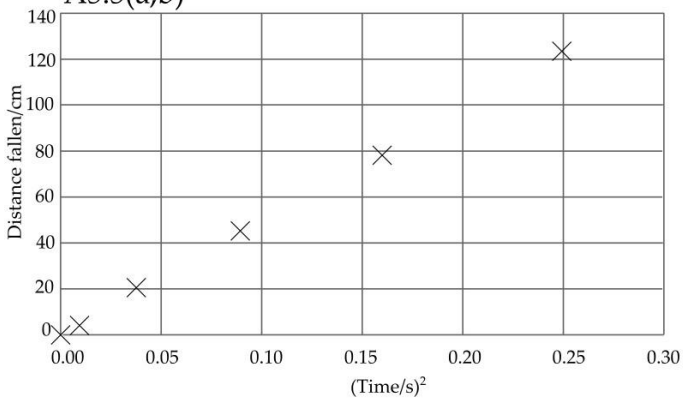
A5.3(a,b)



A5.4(a,b)



A5.5(a,b)



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A6 Equations of Graphs

The table shows the formula for a particular physical relationship, and what has been plotted on the x and y axes. You should write down (in terms of the letters in the formula) what the y-intercept and gradient will be. If the graph is not going to be a straight line, write 'not straight' instead of a gradient.

	Equation	y axis	x axis	y-intercept	Gradient
A6.1	$V = \varepsilon - Ir$	V	I	(a)	(b)
A6.2	$s = \frac{1}{2}gt^2$	s	t^2	(a)	(b)
A6.3	$R = \frac{\rho L}{A} + K$	R	L	(a)	(b)
A6.4	$\frac{L}{T} = \lambda f + D$	T^{-1}	λ	(a)	(b)
A6.5	$\frac{1}{R} = \frac{1}{S} + \frac{1}{T}$	R^{-1}	S^{-1}	(a)	(b)
A6.6	$qV = hf - \phi$	V	f	(a)	(b)
A6.7	$d \sin\theta = n\lambda$	$\sin\theta$	n	(a)	(b)

A7 Area Under the Line on a Graph

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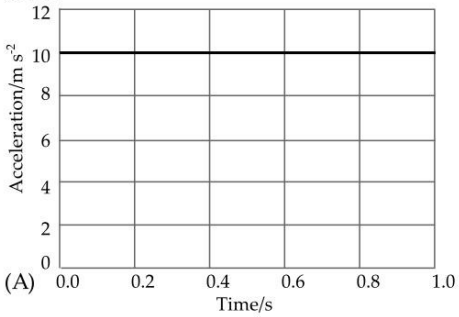
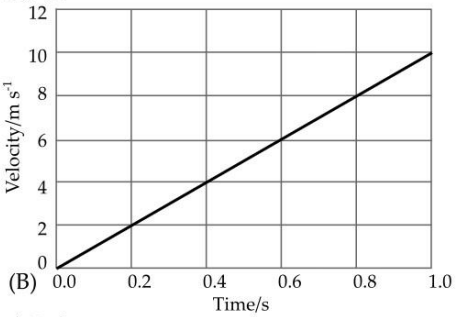
Estimate the physical quantity corresponding to the area under each line on the graphs (A), (B), (C), (D) and (E).

A7.1



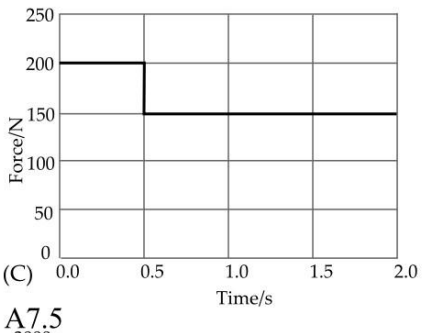
(A)

A7.2



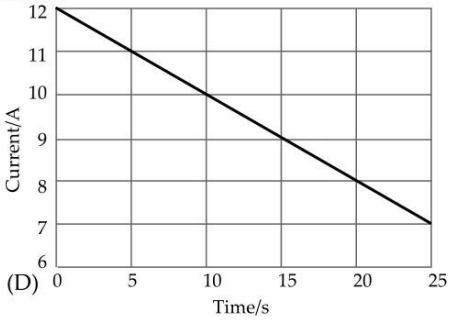
(B)

A7.3



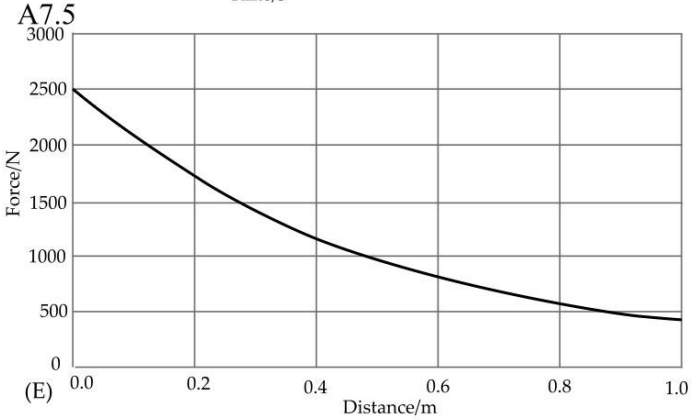
(C)

A7.4



(D)

A7.5



(E)

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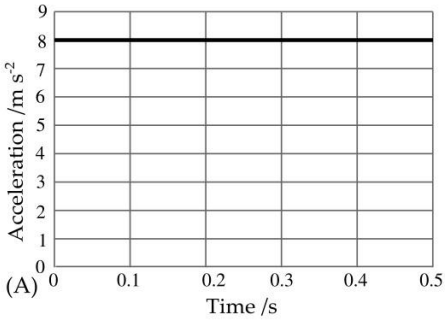
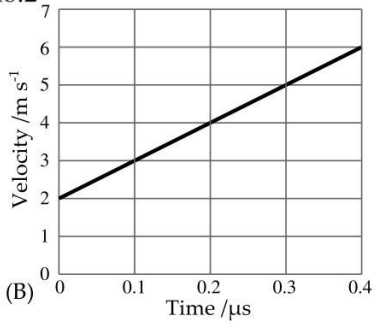
A8 Area Under the Line on a Graph II

Estimate the physical quantity corresponding to the area under each line on the graphs (A), (B), (C), (D) and (E). You must give your answer in standard form in SI units, without prefixes. Incorrect unit = no mark.

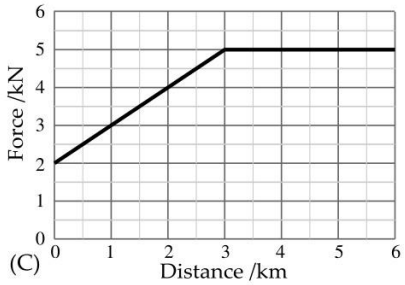
A8.1



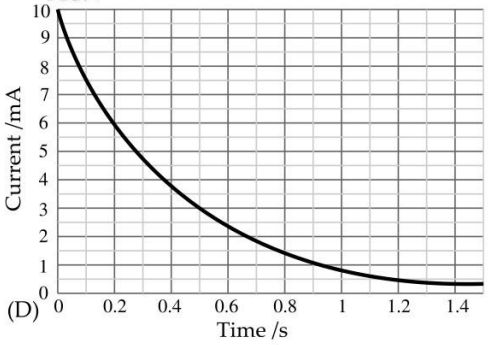
A8.2



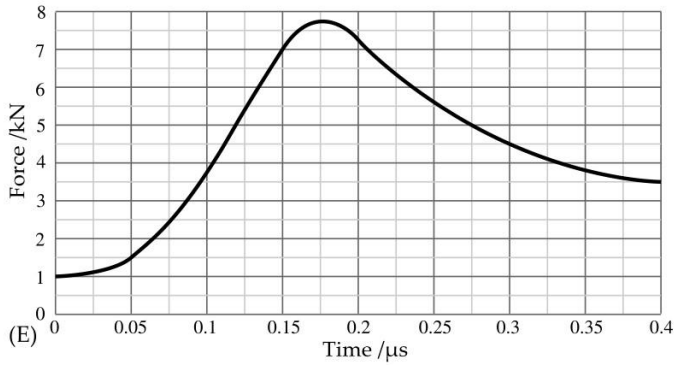
A8.3



A8.4



A8.5



A9 Factor and Percentage Changes

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In questions A9.1 to A9.5, give the factor by which the quantity changes to two significant figures. So if it doubles, your answer is 2.0, and if it halves your answer is 0.50.

A9.1 By what factor does $E = mv^2/2$ change if v doubles?

A9.2 By what factor does

a) $V = -GM/r$ change if r is multiplied by 3.3?

b) $g = GM/r^2$ change if r is multiplied by 0.64?

A9.3 By what factor does v need to change if $E = mv^2/2$ is to halve?

A9.4 By what factor does d need to change in $I = P/(4\pi d^2)$ if P has multiplied by 5.2 and I is not to change?

A9.5 In $GMT^2 = 4\pi^2 r^3$, by what factor does T change if G and M remain constant, and r is multiplied by 3.5?

In questions A9.6 to A9.10, give the percentage change in the quantity. Use "+" or "−" to indicate increase or decrease (so a 3 % decrease would be given as −3 %).

A9.6 In $V = IR$, what is the percentage change in V if I increases by 8 %?

A9.7 In $E = mv^2/2$, what is the percentage change in E if v increases by 3 %

A9.8 In $f = 1/T$, what is the percentage change in f if T increases by 4 %?

A9.9 In $r = \sqrt{(A/\pi)}$, what is the % change in r if A decreases by 6 %?

A9.10 In

a) $E = VIt$, what is the percentage change in E if V increases by 1 %, I decreases by 2 % and t increases by 3 %?

b) $R = \rho L/A$, what is the percentage change in R if L increases by 7 % and A increases by 3 %?

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A10 Proportionality

A10.1 If $V \propto I$ and $I = 0.35$ A when $V = 9.6$ V, what will V be when $I = 0.90$ A?

A10.2 If $E \propto v^2$ and $E = 94$ J when $v = 6.5$ m/s, what will E be when $v = 12$ m/s?

A10.3 If $g \propto 1/r^2$ and $g = 9.8$ N/kg when $r = 6400$ km, what will g be when $r = 15000$ km?

A10.4 If $E \propto x^2$ and $E = 2.5$ J when $x = 1.5$ cm, what will x be when $E = 6.0$ J?

A10.5 If $V \propto 1/r$ and $V = 5000$ V when $r = 7.0$ cm, what will r be when $V = 2000$ V?

A10.6 If $m = \rho a^3$ and $m = 28$ g when $a = 2.5$ cm, what will m be when $a = 8.7$ cm if ρ doesn't change?

A10.7 If $I = P/V$ and $I = 5.2$ A when $V = 230$ V, what will I be when $V = 115$ V if P doesn't change?

A10.8 If $I = P/(4\pi r^2)$ and $I = 6.0$ W/cm^2 when $r = 3.0$ m, what will r be when $I = 0.30$ W/cm^2 if P doesn't change?

A10.9 If $R = \rho L/A$, and $R = 5.0\ \Omega$ when $L = 65$ m and $A = 2.5$ mm^2, what will R be when $L = 120$ m and $A = 1.5$ mm^2 if ρ doesn't change?

A10.10 If $g = GM/r^2$ and $g = 9.8$ N/kg when $M = 6\times10^{24}$ kg and $r = 6400$ km, what will M be if $g = 1.7$ N/kg and $r = 1700$ km if G doesn't change?