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BUDMOUTH COLLEGE

A level Physics pre-course task

This task consists of a combination of higher-level GCSE and lower-demand A level questions.

These questions are designed to introduce you to the kind of skills you will need to succeed at A level physics. They will make you think but you should be able to attempt all of them with a good GCSE grounding and some extra reading/research. We hope you enjoy the challenge!

<u>Useful equations</u>

$E_k = ½ mv^2$

a = v-u/t

V= IR

Refractive index = sin *i*/sin *r*

Refractive index = 1/sin *c*

Good luck!

A common question - Do I need to be good at Maths?

The simple answer to this is that yes – it helps.

BUT the course has been developed so that all of the physics in year 1 can be explained with a good understanding of GCSE mathematics.

In year 2 some more difficult maths is necessary to help explain concepts and analyse data but these skills will be developed as you study.

If you have chosen to do maths as one of your A level courses then you will have an advantage, especially if you are taking mecnanics modules as there is a massive overlap, but it is not essential.
A summary of the kind of mathematical skills required appear below:

1 Arithmetic and numerical computation:
(a) recognise and use expressions in decimal and standard form;
(b) use ratios, fractions and percentages;
(c) use calculators to find and use power, exponential and logarithmic functions;
(e) use calculators to handle sin x, cos x, tan x when x is expressed in degrees or radians.
2 Handling data:
(a) use an appropriate number of significant figures;
(b) find arithmetic means;
(c) make order of magnitude calculations.
3 Algebra:
(a) understand and use the symbols: $=, <, \ll, \gg, >, \propto, \sim$;
(b) change the subject of an equation;
(c) substitute numerical values into algebraic equations using appropriate units for physical quantities;
(d) solve simple algebraic equations.
4 Graphs:
(a) translate information between graphical, numerical and algebraic forms;
(b) plot two variables from experimental or other data;
(c) understand that $y = mx + c$ represents a linear relationship;
(d) determine the slope and intercept of a linear graph;
(e) draw and use the slope of a tangent to a curve as a measure of rate of change;
(f) understand the possible physical significance of the area between a curve and the x axis and be able to calculate it or measure it by counting squares as appropriate;
(g) use logarithmic plots to test exponential and power law variations;
(h) sketch simple functions including $y = k/x$, $y = kx^2$, $y = k/x^2$, $y = \sin x$, $y = \cos x$, $y = e^{-x}$.
5 Geometry and trigonometry:
(a) calculate areas of triangles, circumferences and areas of circles, surface areas and volumes of rectangular blocks, cylinders and spheres;
(b) use Pythagoras' theorem, and the angle sum of a triangle;
(c) use sin, cos and tan in physical problems;
(d) understand the relationship between degrees and radians and translate from one to the other;
(e) use relationship for triangles:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \text{ and } a^2 = b^2 + c^2 - 2bc\cos A.$$

1 **(a)** Define *velocity*.

....

.... **[1]**

(b) The mass of an ostrich is 130 kg. It can run at a maximum speed of 70 kilometres per hour.

(i) Calculate the maximum kinetic energy of the ostrich when it is running.

kinetic energy = ... J **[3]**

(ii) Scientists have recently found fossils of a prehistoric bird known as Mononykus. Fig. 1.1 shows what the Mononykus would have looked like.

Fig. 1.1

According to a student, the Mononykus looks similar to our modern day ostrich. The length, height and width of the Mononykus were all **half** that of an ostrich.
Estimate the mass of the Mononykus. Explain your reasoning.

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.... **[2]**

[Total: 6]

2. Fig. 4.2 shows a tennis ball moving up a smooth ramp at time $t = 0$.

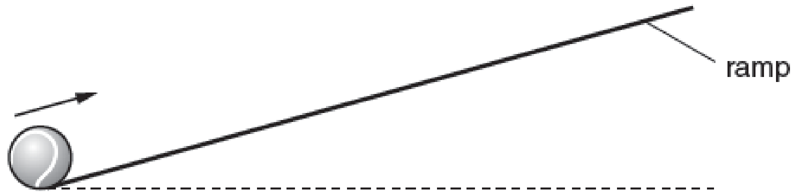

Fig. 4.2

Fig. 4.3 shows a graph of velocity v against time t for this ball.

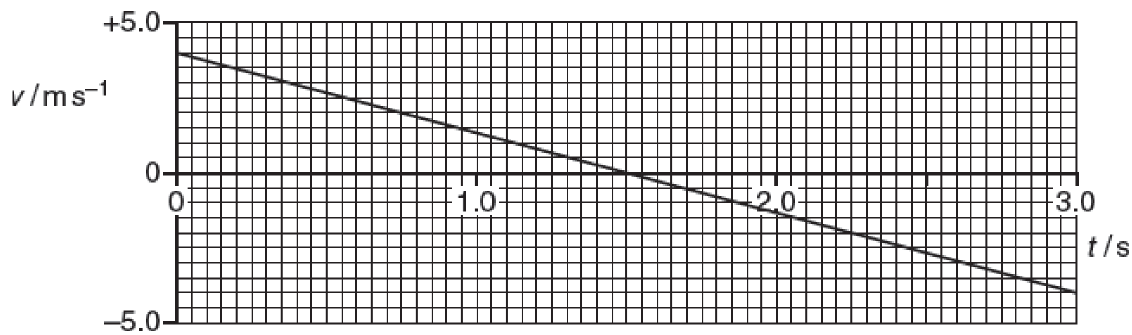

Fig. 4.3

(i) Describe, without calculation, the motion of the ball between $t = 0$ and $t = 3.0$ s.

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....

.... **[3]**

(ii) Calculate the maximum distance D travelled by the ball up the ramp.

D = ... m **[2]**

[Total: 12]

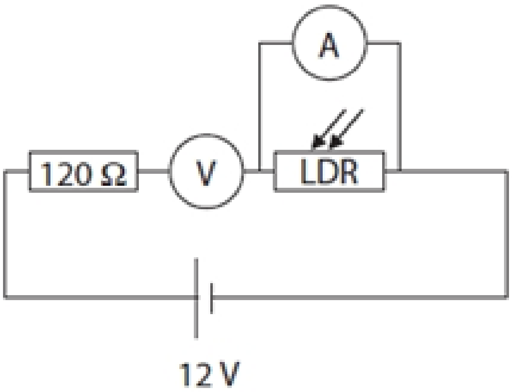
Q3. (a) A technician investigates a light-dependent resistor (LDR) connectedin series with a 120 Ω resistor and a voltage source.

The technician measures the voltage across the LDR and also the current in the LDR.

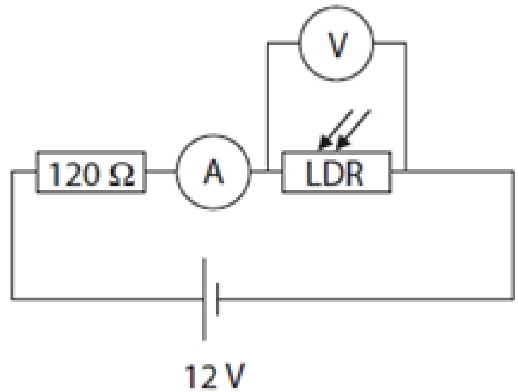
(i) Which **one** of these circuits should the technician use?

Put a cross (☒) in the box next to your answer.

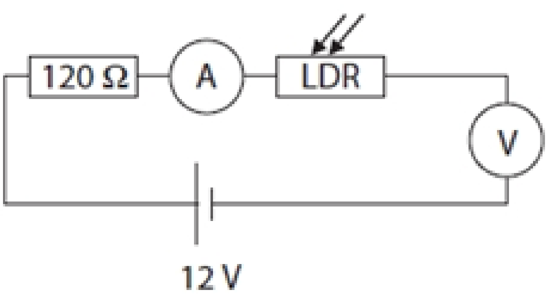
(1)



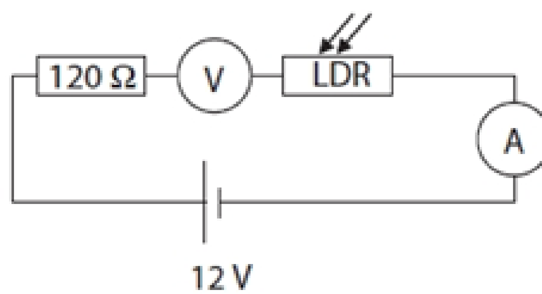
☐ **A**



☐ **B**



☐ **C**



☐ **D**

(ii) When the LDR is in bright sunlight, its resistance is 185 Ω.
The voltage across the LDR is then 7.2V.
Show that the current in the LDR is about 0.039 A.

(2)

(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The current in the 120 Ω resistor is

(1)

☐ **A** much more than the current in the LDR

☐ **B** much less than the current in the LDR

☐ **C** the same as the current in the LDR

☐ **D** the opposite of the current in the LDR

The table gives two of the readings.

light condition	current in LDR
bright sunlight	0.039 A
cloudy skies	0.028 A

Explain why the two current readings are different.

(2)

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*(b) The photograph shows a temporary traffic sign.

The traffic sign uses many small lights all powered by a rechargeable battery.
These lights need to be very bright during the day so that they can be seen clearly.
They do not need to be as bright at night.

Explain how using a light-dependent resistor can make the energy stored in the battery last longer.

(6)

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4 Fig. 4.1 shows a metal ball held stationary above a tube containing oil.

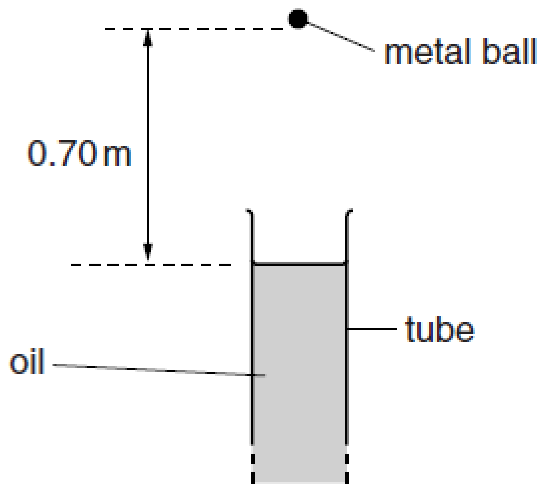

Fig. 4.1

(b) Fig. 4.2 shows the graph of velocity v against time t for the ball as it travels through the oil. The ball enters the oil at time $t = 0$.

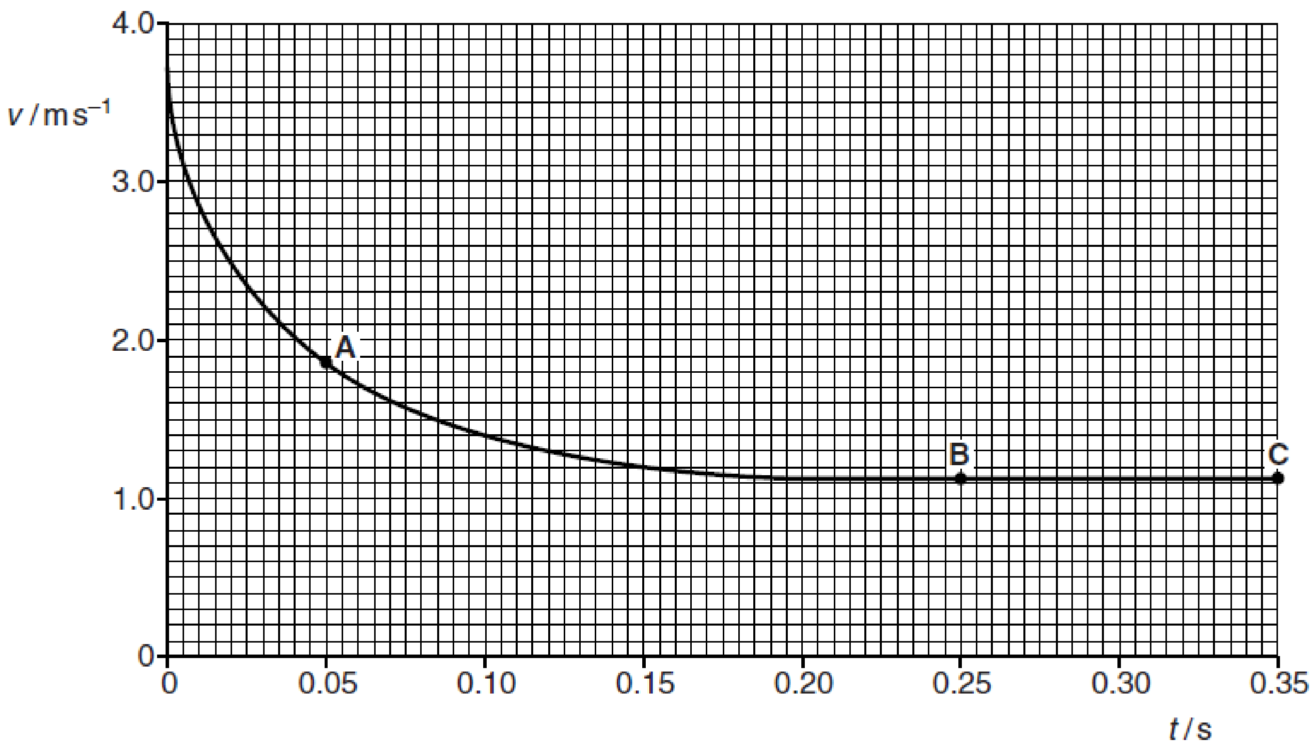

Fig. 4.2

(i) Complete the sentence below.

The gradient of the graph is equal to the .... of the ball and

the area under the graph is equal to the .... **[1]**

(ii) Use Fig. 4.2 to determine the magnitude of the deceleration of the ball at time $t = 0.05\,s$ (point **A**). Show your working.

deceleration = ... $m\,s^{-2}$ **[3]**

(iii) In terms of the **forces** acting on the ball, describe and explain its motion when

1 time $t = 0.05\,s$ (point **A**)

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....

2 time $t = 0.25\,s$ (point **B**).

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[4]

(iv) Describe the energy transfers taking place between $t = 0.25\,s$ and $t = 0.35\,s$ (point **B** to **C**).

....

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.... **[1]**

[Total: 12]

Q5.

(a) You are asked to find the refractive index for light passing from air to glass by tracing the path of a ray of light through a glass block.

State the measurements you would take, the graph you would plot and how you would use the graph to determine a value for the refractive index.

(3)

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(b) (i) State what is meant by critical angle.

(2)

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(ii) Calculate the critical angle for light passing from water to air.
refractive index of water = 1.33

(2)

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Critical angle = ...

(Total for Question = 7 marks)