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Activity

Practice-for-exam questions

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Use the questions below either in class or for individual work after students have read the articles in the magazine. Although the questions state the values of constants required, some of the questions require additional data — students should either make reasonable estimates of quantities or look up values using a data book or website. Students should clearly communicate any assumptions made. Suggested outline answers to questions are provided in a separate document.

Galileo's inclined plane: the world's first particle accelerator

1 **a** Using your knowledge of the constant acceleration equations of motion (sometimes called the suvat equations) calculate the distance a ball falls in freefall, if it is dropped from rest, in 3 seconds.

b Suppose a Galileo's plane, as described in the article, was used to calculate this freefall distance. If the plane was 5 m long, and measurements were taken to plot a graph of the distances s and h, as described in the article, what gradient would you expect to calculate from the graph?

c Suppose that you performed the experiment and found that your results do not perfectly match the theoretical value. What factors might you need to consider and minimise to try to improve the results, and reduce any errors and uncertainties?

Rocket Propulsion

1 The Moon has a mass of approximately 7.3×10^{22} kg and a diameter of approximately 3500 km.

a Calculate the escape velocity for the Moon.

Use $G = 6.67 \times 10^{-11}\, Nm^2\, kg^2$

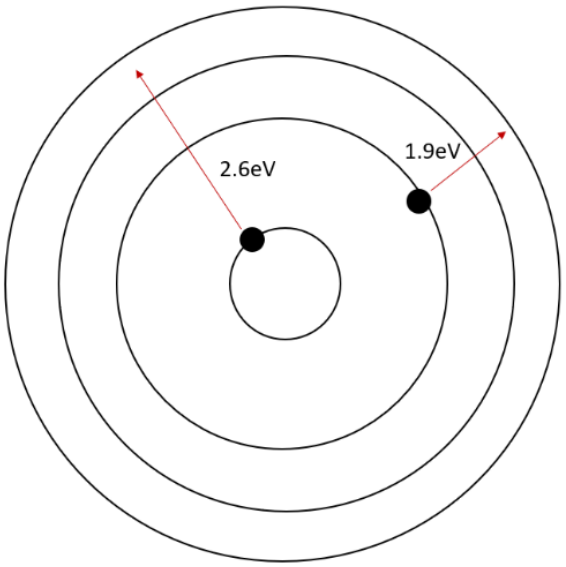
b Imagine that the Moon suddenly collapsed inwards, reducing its diameter by a third but maintaining the same mass. What would the new escape velocity be?

2 ***(extension)*** A rocket is launched in deep space (so you can ignore any effects from gravity). The exhaust velocity of the fuel is $4\ kms^{-1}$. The rocket uses all its fuel, with a total mass of 2 500 000 kg. As a result, the rocket reaches a velocity of $12\ kms^{-1}$. Find the mass of the rocket.

Lasers

1 The diagram shows possible transitions for electrons in an atom. Each transition is labelled with the energy difference, in eV, between the two orbitals. If the transitions could be stimulated to produce laser light, what colours could this system produce?

Use $h = 6.63 \times 10^{-34} js$, $c = 3 \times 10^{8} ms^{-1}$, and $1\text{J} = 6.24 \times 10^{18}\text{eV}$



Taking repeat measurements

1 **a** The table shows data (without units) taken in an experiment. Identify which data points are likely to be anomalous.

Data points	Attempt 1	Attempt 2	Attempt 3	Attempt 4
1	13.2	12.9	13.1	12.8
2	8.1	7.9	8.4	8.1
3	5.3	5.9	7.2	5.4
4	7.9	8.3	7.8	8.1
5	12.8	11.7	13.1	13.0

b Removing the anomalous data points from the data set, calculate the mean value, and the uncertainty, for each data point.

c After performing the experiment it was realised that every measurement was approximately 1.5 larger than the theory would suggest. What kind of error is this?