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Physics review

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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. Some of the questions require additional data: students should either make reasonable estimates of quantities, or look up values using a data book or websites. Suggested outline answers to questions are provided in the answer document.

## Structural colour

**1** A laser pointer emits green light with wavelength 532 nm. When it shines at normal incidence onto a soap film, bright green light is reflected.

What is the smallest thicknesses of soap film that will produce constructive interference with this light? (Assume that the film's refractive index is 1.33.)

**2** The tracks on a CD are thin lines of pits that do not reflect light, etched into the CD's reflective surface. The tracks are separated by 1.60 μm.

When you look at the surface of the CD, light incident on it is reflected and you can see different colours.

**a** Explain, using the principle of interference, why the different colours are seen and why they change when you change your viewing angle.

**b** How many lines per metre does the CD have?

**c** Calculate the angles for the first-order diffraction of the shortest and longest wavelengths of visible light (380 and 760 nm) when light shines onto the CD at normal incidence.

## *At a glance*: Exoplanets

**1** The first exoplanet was discovered when Mayor and Queloz detected changes in the radial velocity of the star 51 Pegasi of about 70 m $s^{-1}$

By how much would this motion change the wavelength of the red spectral line known as H$\alpha$, which has a wavelength of 656.28 nm when measured at rest?

**2** The *resolving power, R,* of a spectrometer is a measure of its ability to detect small differences in wavelength:

$R = \lambda/\Delta\lambda$

where $\Delta\lambda$ is the smallest difference that can be detected at a wavelength $\lambda$

Use information from the article to estimate the minimum resolving power needed to detect a Jupiter-like exoplanet orbiting a Sun-like star.

# A simple pendulum?

**1** A test pendulum used to measure the local value of *g*, the acceleration due to gravity, has an effective length of 402.5 mm and oscillates with a frequency of 0.7873 Hz. Calculate the local value of *g* measured by this pendulum.

**2** Pendulum X has a bob of mass *m* and a string of length *l*. Pendulum Y has a bob of mass 4*m* and string length *l*/4. Both pendulums are displaced from their equilibrium position by the same angle and then released.

Which of the following statements is true:

**A** The frequency of the pendulum Y is 4 times the frequency of pendulum X.

**B** The frequency of the pendulum Y is 2 times the frequency of pendulum X.

**C** The frequency of pendulum Y is equal to that of pendulum X.

**D** The frequency of the pendulum Y is ½ the frequency of pendulum X.

**3** In the section headed 'A light, inextensible string' (p. 21) the author states:

'If the length l can change, then it is likely to be longer when the string is under greatest tension ... this occurs for small angles around the vertical.'

**a** Use your understanding of circular motion to explain why the string is under greatest tension as the pendulum passes through the vertical.

**b** Suppose a pendulum string has an unstretched length *l*, and extends by an amount *x* when it is supporting the pendulum bob at rest. Now suppose that the pendulum is set in motion so that it swings through quite a large angle.

**i** When the pendulum passes through the vertical, would you expect the extension to be:

A zero

B less than *x*

C equal to *x*

D greater than *x*

**ii** Give reasons for your answer.

# *Skillset*: standing waves on a string

These questions are about a guitar.

A standard guitar has six strings. Table 1 shows the frequencies of the notes produced when the full length of each string vibrates at its fundamental frequency.

| String | Frequency/Hz |
|---|---|
| 1 (E) | 329.63 |
| 2 (B) | 246.94 |
| 3 (G) | 196.00 |

| | |
|---|---|
| 4 (D) | 146.83 |
| 5 (A) | 110.00 |
| 6 (E) | 82.41 |

**1** **a** If the distance between the bridge and the nut is 70.0 cm, what is the speed of the travelling wave on string 1 (E)?

**b** Guitar players can cause the second harmonic (twice the fundamental frequency) to sound when pressing on the string with their finger.

How far from the bridge would the player need place their finger to produce the second harmonic?

**2** Guitar strings are tuned by tightening a nut to increase the tension until the correct note is produced when its full length vibrates. The strings are manufactured with different thicknesses, and the strings for 6 (E) are thicker than those for 1 (E).

Suggest an explanation for why different thicknesses are needed. (For example, think about problems that might occur if a guitar player tried to use a string that was much thicker than the correct one.)