INKPHYSICS FLASHCARDS

Astrophysics

Year 13 · 68 cards · fronts and backs

Print double-sided, flipping on the long edge, and each answer lands behind its question. Cut along the card borders.

Definitions in mark-scheme wording, the equations that are not on the AQA data sheet, each lesson's check question, and the misconceptions that lose marks. The same cards run on the website with spaced-repetition scheduling, at inkphysics.co.uk/physics/flashcards.

DEFINITION

Define: Angular magnification.

TELESCOPES AND IMAGE FORMATION

DEFINITION

Define: Normal adjustment.

TELESCOPES AND IMAGE FORMATION

DEFINITION

Define: Chromatic aberration.

TELESCOPES AND IMAGE FORMATION

RECALL

State the cure for spherical aberration.

TELESCOPES AND IMAGE FORMATION

SPOT THE ERROR

Say what is wrong with this claim:

A good telescope is one with the biggest magnification.

TELESCOPES AND IMAGE FORMATION

DEFINITION

Define: Rayleigh criterion.

TELESCOPES ACROSS THE SPECTRUM

DEFINITION

Define: Quantum efficiency.

TELESCOPES ACROSS THE SPECTRUM

RECALL

State the quantum efficiency of a CCD and of the eye.

TELESCOPES ACROSS THE SPECTRUM

DEFINITION

The telescope setting in which the focal planes of the objective and eye lens coincide, so the final image is at infinity and viewed by a relaxed eye.

TELESCOPES AND IMAGE FORMATION

DEFINITION

The angle subtended by the final image at the eye divided by the angle subtended by the object at the unaided eye.

TELESCOPES AND IMAGE FORMATION

RECALL

A parabolic mirror brings every ray parallel to its axis to a single focus.

TELESCOPES AND IMAGE FORMATION

DEFINITION

Glass refracts blue light more than red, so each colour has its own focal length and images carry coloured fringes.

TELESCOPES AND IMAGE FORMATION

DEFINITION

Two point sources are just resolved when the central maximum of one diffraction pattern falls on the first minimum of the other: $\theta \approx \lambda/D$ in radians.

TELESCOPES ACROSS THE SPECTRUM

SPOT THE ERROR

Magnification is not what matters: the objective's diameter fixes the light gathered and the detail resolved, and magnifying a blurred image only gives a bigger blur.

TELESCOPES AND IMAGE FORMATION

RECALL

A CCD registers about 80% of incident photons; the eye registers about 1%.

TELESCOPES ACROSS THE SPECTRUM

DEFINITION

The fraction of the photons arriving at a detector that are actually registered.

TELESCOPES ACROSS THE SPECTRUM

RECALL

Explain why X-ray telescopes use grazing incidence.

TELESCOPES ACROSS THE SPECTRUM

EQUATION · NOT ON THE AQA DATA SHEET

Collecting power and objective diameter:

collecting power $\propto D^2$?

TELESCOPES ACROSS THE SPECTRUM

SPOT THE ERROR

Say what is wrong with this claim:

Observatories sit on mountaintops to be closer to the stars.

TELESCOPES ACROSS THE SPECTRUM

DEFINITION

Define: Apparent magnitude.

STAR BRIGHTNESS AND MAGNITUDE

RECALL

State the brightness factor for a difference of one magnitude.

STAR BRIGHTNESS AND MAGNITUDE

RECALL

State the brightness factor for a difference of five magnitudes.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

Define: Absolute magnitude.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

Define: Parsec.

STAR BRIGHTNESS AND MAGNITUDE

EQUATION · NOT ON THE AQA DATA SHEET

collecting power ∝ D^2

TELESCOPES ACROSS THE SPECTRUM

RECALL

X-rays pass into an ordinary mirror, so they are focused by skimming off nested metal surfaces at grazing incidence.

TELESCOPES ACROSS THE SPECTRUM

DEFINITION

A star's brightness as seen from Earth, on a scale where smaller numbers mean brighter stars.

STAR BRIGHTNESS AND MAGNITUDE

SPOT THE ERROR

The altitude gain is negligible against astronomical distances: mountaintop sites sit above most of the turbulent, absorbing atmosphere, giving steadier images and access to infrared wavelengths.

TELESCOPES ACROSS THE SPECTRUM

RECALL

A difference of five magnitudes is a brightness factor of exactly 100.

STAR BRIGHTNESS AND MAGNITUDE

RECALL

A difference of one magnitude is a brightness factor of about 2.51.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

The distance at which one astronomical unit subtends an angle of one arcsecond.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

The apparent magnitude a star would have at a distance of 10 parsecs.

STAR BRIGHTNESS AND MAGNITUDE

RECALL

State the parsec in light years.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

Define: Astronomical unit.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

Define: Light year.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

Define: Distance modulus.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

Define: Parallax angle.

STAR BRIGHTNESS AND MAGNITUDE

RECALL

State the parallax equation and the units it needs.

STAR BRIGHTNESS AND MAGNITUDE

EQUATION · NOT ON THE AQA DATA SHEET

Radiation flux from luminosity and distance:

F = ?

STAR BRIGHTNESS AND MAGNITUDE

SPOT THE ERROR

Say what is wrong with this claim:

The bigger a star's magnitude number, the brighter it shines.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

The mean distance from the Earth to the Sun, 1.50×10^{11} m.

STAR BRIGHTNESS AND MAGNITUDE

RECALL

One parsec is about 3.26 light years.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

The difference m - M between apparent and absolute magnitude, equal to 5 log(d/10) with d in parsecs.

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

The distance light travels through a vacuum in one year, 9.46×10^{15} m.

STAR BRIGHTNESS AND MAGNITUDE

RECALL

p = 1/d, with p the parallax in seconds of arc and d the distance in parsecs. The units are part of the equation: the parsec was defined to make the constant exactly one, so the relation is false in any other pair of units. (OCR only.)

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

The angle that one astronomical unit subtends at a star, which is half the total sideways shift the star appears to make against the distant background over six months.

STAR BRIGHTNESS AND MAGNITUDE

SPOT THE ERROR

The magnitude scale runs backwards: smaller numbers mean brighter stars, and the brightest objects have negative magnitudes.

STAR BRIGHTNESS AND MAGNITUDE

EQUATION · NOT ON THE AQA DATA SHEET

$$F = (L)/(4\pi d^2)$$

STAR BRIGHTNESS AND MAGNITUDE

DEFINITION

Define: Black body.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

State what the black-body spectrum depends on.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

State the spectral class order.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

State the unit of the Wien constant.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

State the Balmer absorption condition.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

State where Balmer lines are strongest.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

SPOT THE ERROR

Say what is wrong with this claim:

A red-hot star is hotter than a white one.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

DEFINITION

Define: Hertzsprung-Russell diagram.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

The radiation spectrum of a black body depends only on its temperature.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

DEFINITION

A body that absorbs all radiation falling on it, and is therefore the best possible emitter.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

The metre kelvin (m K), a product: $\lambda_{max}T = 2.9 \times 10^{-3}$ m K.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

O B A F G K M, running from the hottest stars to the coolest.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

In class A stars: hot enough to lift many atoms into n = 2, cool enough not to ionise the hydrogen.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

Hydrogen can only absorb the visible Balmer lines from atoms already excited to the n = 2 level.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

DEFINITION

A plot of stellar luminosity or absolute magnitude against temperature or spectral class.

THE HR DIAGRAM AND STELLAR EVOLUTION

SPOT THE ERROR

Red stars are the coolest, at about 3000 K, not the hottest: Wien's law says a hotter star peaks at a shorter wavelength, so colour moves from red towards blue-white as temperature rises.

BLACK-BODY RADIATION AND SPECTRAL CLASSES

RECALL

State how the temperature axis runs on the HR diagram.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Planet.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Planetary satellite.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Comet.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Solar system.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Galaxy.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Universe.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Chandrasekhar limit.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

A body in orbit around a star, massive enough for its own gravity to have pulled it into a nearly spherical shape and to have swept its orbital neighbourhood clear. It does not fuse, so it shines only by reflected light. (OCR A names this set.)

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

Temperature on the Hertzsprung-Russell diagram runs backwards, decreasing from left to right.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

A small body of ice, dust and rock orbiting a star on a highly elliptical path. Near the star the ice vaporises, and radiation pressure and the stellar wind blow the gas and dust into a tail that always points away from the star. (OCR A.)

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

A body in orbit around a planet rather than around the star directly, covering both natural moons and artificial satellites. (OCR A.)

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

A gravitationally bound collection of stars, gas, dust and dark matter, from millions to hundreds of billions of stars, usually with a supermassive black hole at its centre. (OCR A.)

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

A star together with everything gravitationally bound to it: its planets, their satellites, and the asteroids, comets and dust between them. (OCR A.)

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

About 1.4 solar masses, the greatest core mass electron degeneracy pressure can support as a white dwarf.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Everything that exists: all matter and radiation, together with the space and time they occupy. (OCR A.)

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

State the peak absolute magnitude of a type Ia supernova.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Schwarzschild radius.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

State the properties of a neutron star.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Planetary nebula.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

State where the supergiants sit on the HR diagram.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

Explain the evolution of a massive star after the main sequence.

THE HR DIAGRAM AND STELLAR EVOLUTION

SPOT THE ERROR

Say what is wrong with this claim:

The Sun will end its life in a supernova.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Red shift.

THE DOPPLER EFFECT AND HUBBLE'S LAW

DEFINITION

The radius of the event horizon: $R_s \approx 2GM/c^2$.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

Type Ia peaks cluster close to absolute magnitude -19.3. They are not identical: the peak is standardised using the rate at which the light curve declines, which is what makes them usable as standard candles.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

The glowing shell of gas thrown off by a low-mass star at the end of its red giant stage, lit by the hot exposed core it leaves behind. The name is historical and no planets are involved.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

One to two solar masses within a radius of roughly 10 km, at a density comparable with an atomic nucleus.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

It swells into a red supergiant while its core fuses on through carbon, oxygen and silicon as far as iron, where fusion stops releasing energy. The core then collapses and the star detonates as a core-collapse supernova, leaving a neutron star, or a black hole if the surviving core is heavy enough.

THE HR DIAGRAM AND STELLAR EVOLUTION

RECALL

In a band right across the top of the diagram, above the red giants, with the red supergiants at its cool end: tens of thousands of times the Sun's luminosity at a cool surface temperature, which by Stefan's law makes them hundreds of times the Sun's radius.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

The fractional increase in the wavelength of light from a receding source: $z = \Delta\lambda/\lambda$.

THE DOPPLER EFFECT AND HUBBLE'S LAW

SPOT THE ERROR

The Sun is too light to go supernova: it will become a red giant, shed its outer layers, and end as a cooling white dwarf. Only far more massive stars explode.

THE HR DIAGRAM AND STELLAR EVOLUTION

DEFINITION

Define: Cosmic microwave background.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

State the origin of the cosmic microwave background.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

State what the CMB shows.

THE DOPPLER EFFECT AND HUBBLE'S LAW

DEFINITION

Define: Hubble's law.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

State how to find the age of the universe from H.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

State when $z = v/c$ is valid.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

Explain the Big Bang evidence from element abundances.

THE DOPPLER EFFECT AND HUBBLE'S LAW

DEFINITION

Define: Cosmological principle.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

The red-shifted, cooled radiation left over from the hot early universe.

THE DOPPLER EFFECT AND HUBBLE'S LAW

DEFINITION

Black-body radiation at 2.7 K arriving almost uniformly from every direction.

THE DOPPLER EFFECT AND HUBBLE'S LAW

DEFINITION

The recession speed of a galaxy is proportional to its distance: $v = Hd$.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

The cosmic microwave background is strong evidence for the Big Bang.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

The Doppler formulas $\Delta f/f = v/c$ and $z = \Delta\lambda/\lambda$ hold only for speeds much less than c.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

Assuming constant recession speeds, the age is about $1/H$, with H expressed in s^{-1}.

THE DOPPLER EFFECT AND HUBBLE'S LAW

DEFINITION

The assumption that, on a large enough scale, the universe is homogeneous (the same composition and density everywhere), isotropic (looking the same in every direction) and governed by the same laws of physics everywhere.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

The roughly three-to-one hydrogen-helium mass ratio matches fusion in the first minutes of a hot early universe.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

State what the Big Bang means for space and time.

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

State the main stages in the evolution of the universe after the Big Bang.

THE DOPPLER EFFECT AND HUBBLE'S LAW

EQUATION · NOT ON THE AQA DATA SHEET

Observed frequency from a source moving towards you:

$f_o = ?$

THE DOPPLER EFFECT AND HUBBLE'S LAW

SPOT THE ERROR

Say what is wrong with this claim:

The Big Bang was an explosion at a point in space, and the galaxies are its shrapnel.

THE DOPPLER EFFECT AND HUBBLE'S LAW

DEFINITION

Define: Quasar.

QUASARS AND EXOPLANETS

RECALL

State the power output of a quasar.

QUASARS AND EXOPLANETS

DEFINITION

Define: Radial velocity method.

QUASARS AND EXOPLANETS

DEFINITION

Define: Transit method.

QUASARS AND EXOPLANETS

RECALL

Quarks bind into protons and neutrons within about a microsecond; those nuclei fuse between roughly one second and twenty minutes, fixing the three-to-one hydrogen to helium ratio; atoms form at about 380 000 years and 3000 K, releasing the microwave background; the first stars and galaxies form over the next few hundred million years; and the expansion has been accelerating for the last few billion, reaching 13.8 billion years today. (OCR only.)

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

It was not an event at some address within space. It is where space-time itself begins, and the expansion measured today is that same space-time still stretching.

THE DOPPLER EFFECT AND HUBBLE'S LAW

SPOT THE ERROR

The Big Bang was not an explosion at a point: space itself expands, carrying every galaxy away from every other, so there is no centre and every observer sees recession v = Hd.

THE DOPPLER EFFECT AND HUBBLE'S LAW

EQUATION · NOT ON THE AQA DATA SHEET

$$f_o = (f_s v)/(v - v_s)$$

THE DOPPLER EFFECT AND HUBBLE'S LAW

RECALL

A quasar outshines an entire galaxy from a volume comparable in size to the solar system.

QUASARS AND EXOPLANETS

DEFINITION

The active nucleus of a distant galaxy, powered by matter falling into a supermassive black hole.

QUASARS AND EXOPLANETS

DEFINITION

Detecting an exoplanet from the periodic dip in a star's brightness as the planet crosses its face.

QUASARS AND EXOPLANETS

DEFINITION

Detecting an exoplanet from the periodic Doppler shift of its star's spectral lines as star and planet orbit their common centre of mass.

QUASARS AND EXOPLANETS

RECALL

State the transit dip depth.

QUASARS AND EXOPLANETS

RECALL

Explain how quasar size is found from variability.

QUASARS AND EXOPLANETS

RECALL

State what the radial velocity wobble gives.

QUASARS AND EXOPLANETS

SPOT THE ERROR

Say what is wrong with this claim:

We find planets around other stars by photographing them beside their suns.

QUASARS AND EXOPLANETS

RECALL

Brightness changes over days limit a quasar to about a light-day across, since nothing can vary faster than light crosses it.

QUASARS AND EXOPLANETS

RECALL

The fractional dip in brightness equals $(r_p/r_s)^2$, the squared ratio of planet radius to star radius.

QUASARS AND EXOPLANETS

SPOT THE ERROR

Direct photographs are rare because the star vastly outshines the planet: most exoplanets are found indirectly, from the star's periodic Doppler shift or the small dip in brightness during a transit.

QUASARS AND EXOPLANETS

RECALL

The period of the wobble is the planet's orbital period; its size reflects the planet's mass.

QUASARS AND EXOPLANETS