Unit 26 · Recent Trends in Physics

WORKSHEET

Full marks 36

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 36

1 Key words [4]

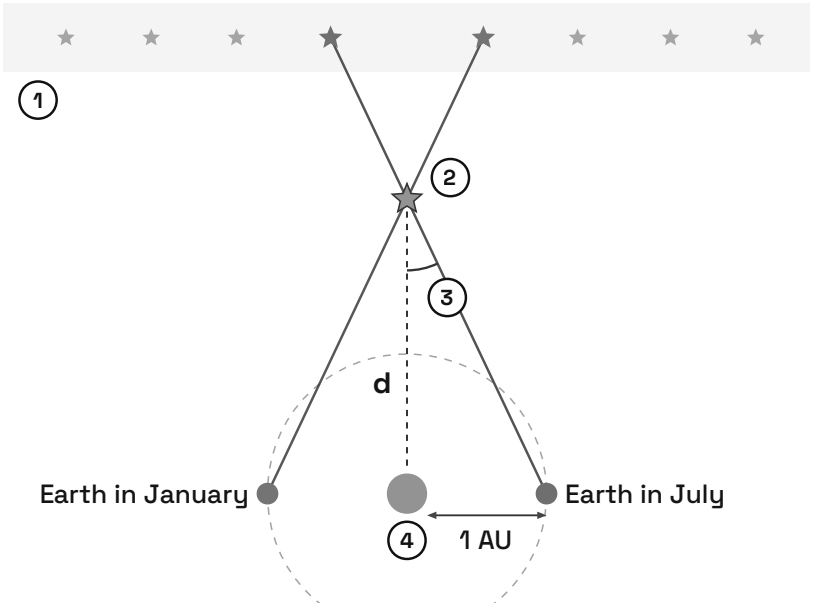
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

antiparticle	baryon	hadrons	horizon	isotope	leptons	meson	nucleon	principle	redshift

A particle with the same mass as another but the opposite charge is its _____. Particles made of quarks, which feel the strong force, are _____. A hadron of three quarks is a _____, and one of a quark and an antiquark is a _____. Particles that don't feel the strong force, such as the electron and the muon, are _____. The stretching of the wavelengths of light from a galaxy moving away from us is its _____. The assumption that the universe is homogeneous and isotropic on a large scale is the cosmological _____. The surface round a black hole beyond which no signal can reach us is its event _____.

2 Label the diagram [2]

The diagram shows how a star's parallax is measured. Write the labels that belong in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The omega-minus particle is made of three strange quarks, sss. Its charge is: [1]

a. +e
b. 0
c. −e
d. −3e

ii. The baryon number of a meson is: [1]

a. +1
b. 0
c. −1
d. +⅔

iii. Which of these is a boson? [1]

a. an electron
b. a proton
c. a neutrino
d. a photon

iv. Twice as far away as another galaxy, a galaxy by Hubble's law moves away: [1]

a. at the same speed
b. twice as fast
c. half as fast
d. four times as fast

v. About how much of the universe's mass–energy is ordinary matter, made of atoms? [1]

a. 5 %
b. 27 %
c. 68 %
d. 95 %

4 Very short answers [3]

Write very short answers to the following questions.

a. Name the six flavors of quark. [1]

b. What is the temperature of the cosmic microwave background today? [1]

c. Why can't a black hole be seen directly? [1]

5 Short answers [6]

Write short answers to the following questions.

a. Find the charge and the baryon number of an antineutron, made of $\bar{u}\bar{d}\bar{d}$. [2]

b. Write two ways in which black holes can be observed, though they give out no light. **[2]**

c. Why is the Big Bang not an explosion of matter from one point into empty space? **[2]**

6 Long answer **[4]**

Write a long answer to the following question.

State Hubble's law. Explain how the redshift of distant galaxies gives evidence that the universe is expanding and began with a Big Bang.

7 Numerical problems **[9]**

Solve the following problems. Show your working. Take $c = 3.0 \times 10^8$ m/s, 1 pc = 3.26 light years and $H_0 = 70$ km/s per Mpc.

a. A galaxy is 200 Mpc away. Find its recessional speed, its redshift, and the wavelength at which a hydrogen line of 656.3 nm is observed in its light. **[3]**

Answer:

b. A star's parallax angle is 0.38 second of arc. How far away is it, in parsecs and in light years? How long ago did the light we see from it leave it? **[3]**

Answer: _____

c. In the reaction $p + p \rightarrow p + n + X$, use conservation of charge and baryon number to find X's charge and baryon number, and suggest its quarks. **[3]**

Answer: _____

8 Think **[3]**

If the universe were infinite, unchanging and full of stars, every line of sight would end on a star and the night sky would be bright. Explain how the Big Bang model explains why the night sky is dark.

9 Activity: Hubble's law on a balloon (Activity 26.1) (not marked)

Draw dots on a balloon blown up a little, choose one as "our galaxy", and measure the distance to four others along the surface. Blow it up to about twice the size and measure again.

Dot	Distance before (cm)	Distance after (cm)	Increase (cm)
A			
B			
C			
D			

Plot the increase against the distance before. What do you find? Would the result be different if you had chosen another dot as "our galaxy"?