Unit 25 · Recent Trends in Physics

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

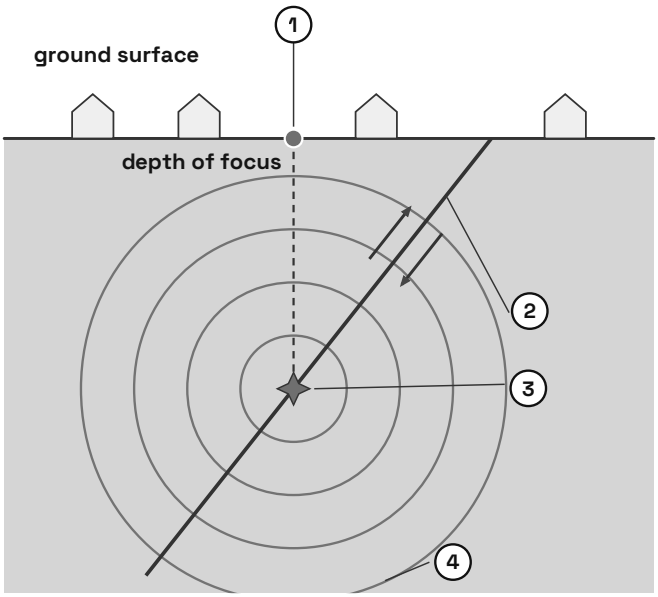
1 Key words [3]

Match each term in Column A with its meaning in Column B. One item in Column B is not needed. Each pair carries 0.5 mark.

Column A		Column B
1. epicenter	☐	**a.** a wave that travels only through liquids
2. aftershock	☐	**b.** the field that gives fundamental particles their mass
3. Love wave	☐	**c.** the point on the Earth's surface straight above where an earthquake begins
4. gravitational wave	☐	**d.** a smaller earthquake that follows the main shock
5. Higgs field	☐	**e.** work with matter between 1 and 100 nm
6. nanotechnology	☐	**f.** a ripple of space-time that travels at the speed of light
		g. a surface wave that shakes the ground from side to side

2 Label the diagram [2]

The diagram is a slice through the ground across a fault. Write the label that belongs 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. An earthquake of magnitude 6.5 releases about how many times the energy of one of magnitude 5.5? [1]

a. 10 **b.** 32

c. 100 **d.** 1000

ii. Seismographs on the far side of the Earth from an earthquake record P waves but no S waves. This shows that the Earth's outer core is: [1]

a. solid iron **b.** liquid

c. a gas **d.** empty

iii. LIGO detects a gravitational wave as: [1]

a. a flash of light from the black holes

b. a sound from space

c. a tiny change in the lengths of its two arms, seen as light reaching its detector

d. a shaking of the ground at one detector

iv. A human hair is about 80 000 nm wide. How many times wider is it than a 100 nm particle? [1]

a. 80 **b.** 800

c. 8000 **d.** 8×10^6

v. In the Standard Model, the photon has no mass because it: [1]

a. moves at the speed of light **b.** does not interact with the Higgs field

c. interacts strongly with the Higgs field **d.** is a boson

4 Short answers [6]

Write short answers to the following questions.

a. Why do surface waves do more damage than body waves? [2]

b. Why does LIGO need two detectors, 3000 km apart? [2]

c. Why does a material made of nanoparticles behave differently from a large piece of the same material? [2]

5 Long answer [4]

Write a long answer to the following question.

Explain how LIGO hears a gravitational wave. Why was it so hard to detect one?

6 Numerical problems [10]

Solve the following problems. Show your working.

a. Earthquake A has a magnitude of 6.2 and earthquake B 4.2. Compare i. the heights of their waves on a seismograph, and ii. the energies they release. **[3]**

Answer:

b. At a seismograph, the S waves of an earthquake arrive 20 s after the P waves. Taking the P waves' speed as 7.0 km/s and the S waves' as 4.0 km/s, how far away is the earthquake? **[3]**

Answer:

c. A 1 cm cube of gold is cut into cubes 10 nm on a side. Find i. how many small cubes it makes, ii. the surface area of the large cube, iii. the total surface area of the small cubes, and iv. how many times as large the surface has become. **[4]**

Answer: _____

7 Think **[3]**

An earthquake starts at a shallow focus 150 km from a city. A sensor near the epicenter feels the P waves almost at once and sends a warning by radio, which arrives in a moment. Taking the S waves' speed as 4.0 km/s, how many seconds' warning does the city get before the S waves arrive? Why is such a warning of little use in a town right beside the epicenter?

8 Activity: Cutting a cube (not marked)

Make a cube of clay or soap 4 cm on a side. Cut it in half each way to make 8 cubes of 2 cm, then cut each of those the same way into cubes of 1 cm. Each time, work out the total surface area.

Side of each cube	Number of cubes	Total surface (cm^2)	Total volume (cm^3)
4 cm	1		
2 cm	8		
1 cm	64		

What happens to the surface each time the side is halved? What does this say about nanoparticles?