

Emanuel School

PHYSICS

3rd year

Thursday 14th June, 2001
2.05 p.m. to 3.25 p.m.

Set by JN

Return to JN

Model answers

Instructions

- Write your name and set in the spaces above.
- Answer all the questions.
- Do all rough work in this booklet.
- Cross through any work you do not want marked.
- You may use a calculator, but show *all* working

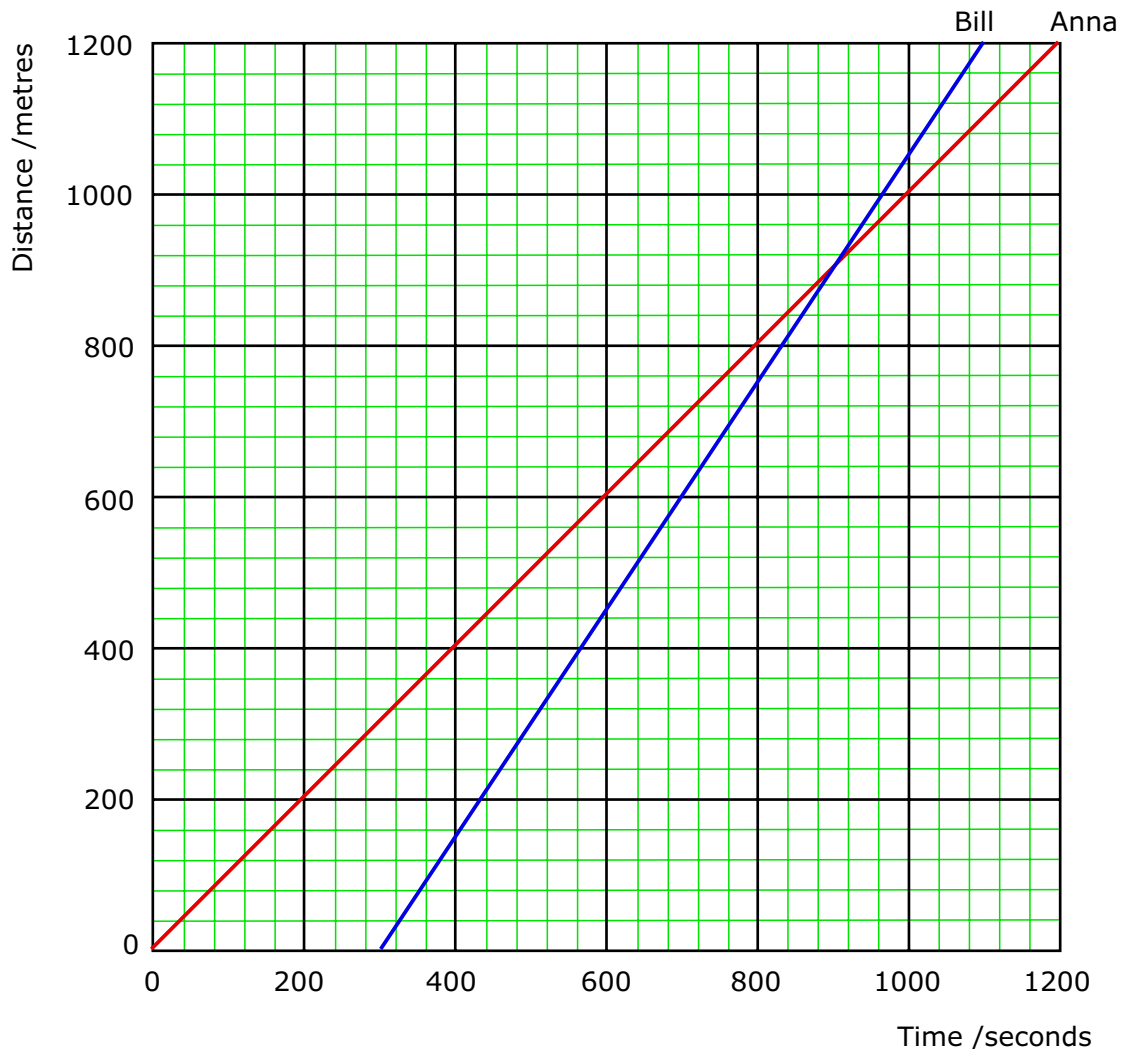
Information

- The time allowed for this exam is 1 hour 20 minutes
- No additional materials are required.
- Mark allocations are shown in brackets.

The maximum mark available for this paper is 100.

- 1 Anna and Bill walk the same route from home to school. Anna sets off first, followed by Bill 5 minutes later. The distance from their home to the school is 1.2 km. Anna walks at a steady speed of 1 m/s. Bill can walk faster at 1.5 m/s.
- (a) How many seconds does it take Anna to complete the walk to school?

- $Time = 1200/1 = \underline{1200 \text{ seconds}}$ [1]



- (b) Draw a distance-time graph for Anna's walk on the grid below [4]

- (c) How long does it take Bill to reach school?

- $Time = 1200/1.5 = \underline{800 \text{ seconds}}$ [1]

- (d) Draw a distance-time graph for Bill's walk on the grid above. [2]

- (e) Does Bill reach school before Anna? If so, how long must he wait for Anna to arrive?

- *Yes.*
- *Bill waits 100 seconds for Anna* [1]

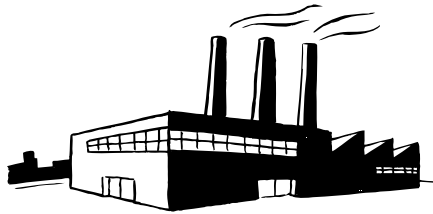
- (f) Does Bill catch up with Anna? How can you tell this from the graph?

- *Bill catches up with Anna where their graphs cross* [1]

- (f) How long does it take Bill to catch up with Anna from the moment he sets out from home, and how far are they from school when he does?

- *From the graph between 560 and 600 seconds after Bill begins walking*

- 2 (a) (i) Sally wrote "Coal traps energy from the Sun". Explain what Sally means.
- *Energy from Sun provided energy for trees to grow*
 - *These trees were fossilised to form coal* [2]
- (ii) Coal is called a non-renewable resource. What does this mean?
- *Once energy resource is used*
 - *It is not replaced* [2]
- (iii) Give two further examples of non-renewable energy resources.
- *Oil / natural gas / geothermal / nuclear* [2]
- (iv) Explain what a renewable energy resource is & give an example of such a resource.
- *A renewable resource is replaced*
 - *when used*
 - *examples: biomass/wind/waves/solar* [3]
- (b) The diagram shows the waste products from a coal-fired power station.



- (i) In what form does the power station waste energy? *Thermal / heat* [1]
- (ii) What is the useful form of energy produced by a coal fired-power station? *Electrical energy* [1]

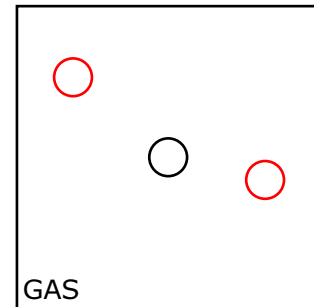
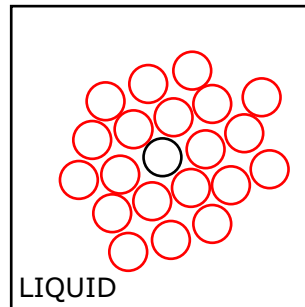
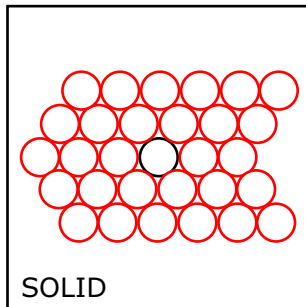
For every 1000 Joules of chemical energy in the coal that is burned in this power station, 300 Joules of electrical energy are produced.

- (iii) Calculate the efficiency of the power station. Begin by writing down the equation you are going to use.
- *Efficiency = (useful work done/total work done) \times 100%* [2]
 - *Efficiency of power station = (300/1000) \times 100 = 30%* [1]

Electrical energy can also be generated by windmills. However, a windmill is much less efficient as a source of electrical energy than a coal fired power station. Yet many people believe that it would be better to generate our electricity with windmills than it would be using coal fired power stations. Explain this.

- *Energy in wind is 'free'/costs nothing* [1]
- *Wind is a renewable resource/ wind energy is inexhaustible* [1]
- *Coal is not a renewable resource/ Coal will eventually run out* [1]

- 3 (a) The circle at the centre of each square represents an atom. In each case add further circles to show how atoms are arranged in each of the states of matter. [3]



Write a sentence to describe how atoms are arranged in

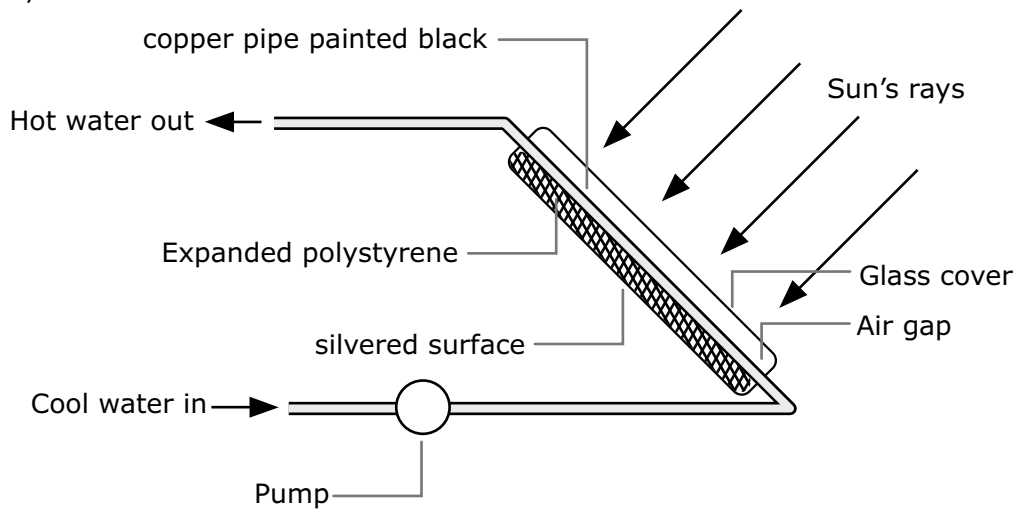
- (i) a solid *atoms touch one another & are arranged in an orderly way* [2]
- (ii) a liquid *atoms are not quite touching & they are not in any orderly arrangement* [2]
- (iii) a gas *atoms are far apart & move independently from one another* [2]

- (b) The diagram shows the apparatus used to demonstrate an important fact concerning atoms in the gas state.



- (i) What are the tiny specks of light that can be seen through the microscope?
 • *Smoke Particles* [1]
- (ii) How would you describe the way they move around?
 • *They move around at random* [1]
- (iii) What makes them move around?
 • *Collisions with atoms/molecules of air/gas* [2]
- (iv) What is the name given to the motion of these specks?
 • *Brownian motion* [1]
- (v) What is this experiment supposed to show?
 • *It shows that atoms/molecules of air/gas move around at random at high speeds* [1]

- 4 (a) The diagram shows part of a solar water heater. Water circulating through the solar panel is heated by the Sun.



- (i) Complete the following sentence.

Heat energy is transferred from the Sun to the solar panel by *Radiation* [1]

- (ii) The pipe inside the solar panel is black. Why?

- *A black surface is an excellent/the best absorber of infra red/thermal radiation* [1]

- (iii) There is a layer of expanded polystyrene behind the black pipe. Why?

- *keeps pipes hot by preventing conduction of heat* [1]

- (iv) A silvered surface is used at the back of the solar panel. Explain why.

- *A silver surface is a poor emitter of thermal radiation* [1]
- *so prevents loss due to radiation* [1]

- (b) The manufacturers of these solar panels claim that installing a solar water heater in your home may help to conserve the environment. Explain how.

Solar radiation does not have a harmful effect on nature

Solar radiation is a substitute for fossil fuels which do produce harmful waste products when burned. [2]

5 (a) How and when was the moon formed? Use a diagram if necessary

• *Moon formed 4.5 billion years ago* [1]

• *Due to collision between* [1]

• *Two large planet sized bodies* [1]

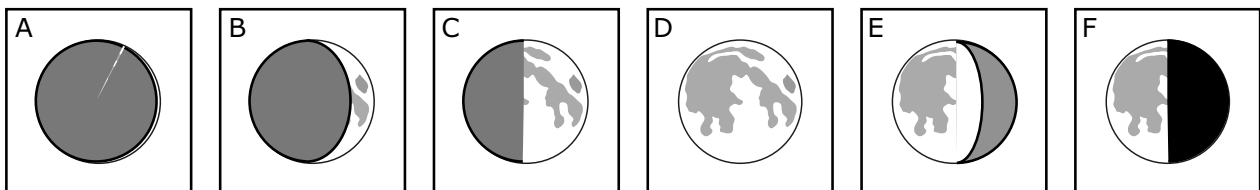
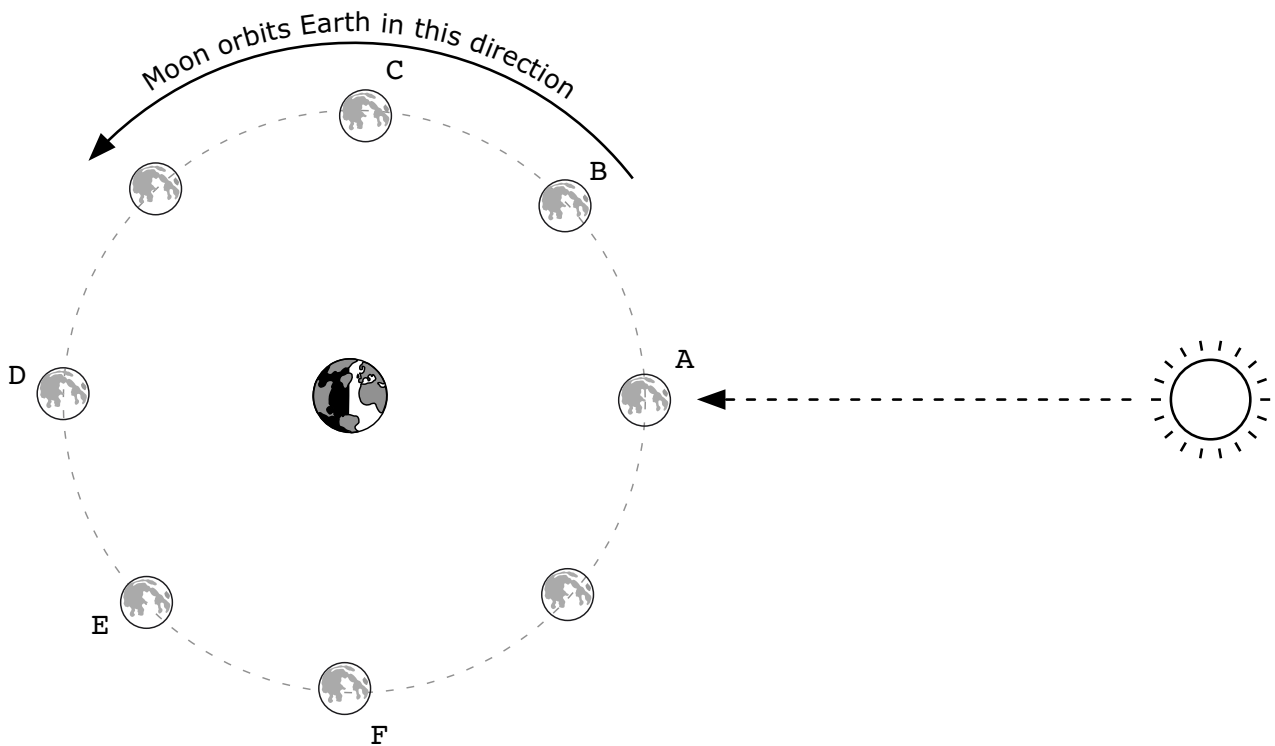
(b) Most of the moon is covered in craters. What is a crater and what causes a crater to be formed?

• *A crater is a hole made* [1]

• *by a large interplanetary object/asteroid/comet/meteoroid* [1]

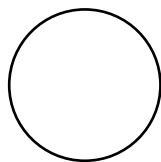
• *when it collides with the surface of a planet or a moon* [1]

(c) What does the moon look like from the earth at each of the positions shown in the diagram below? Draw a sketch in each of the labelled boxes below and name the phase. F has been done for you [2 marks for each correct diagram]



A New Moon, B is a crescent Moon, C is First quarter moon, D is Full Moon, E is a Gibbous Moon.

- (d) Describe what the Earth looks like seen from the Moon when the Moon is at position C?
 • *Just like a first quarter Moon/ like a 'D'* [2]
- (e) What is the Moon's phase during a solar eclipse?
 • *New Moon* [1]
- (f) What is the Moon's phase during a lunar eclipse?
 • *Full Moon* [1]
- (g) If you were on the Moon during a lunar eclipse and you were looking towards the sun, what would you expect to see?
 • *The Sun would be hidden behind the Earth* [2]
- (h) The Earth, the Moon and the Sun are all bodies in the Solar System.
- (i) Which of these can be seen by the light that it gives out? *The Sun* [1]
- (ii) A student is making a model to show the size and position of the Earth, the Moon and the Sun. She uses a football, a tennis ball and a table-tennis ball.
- (iii) She chooses the football to represent the Sun. Why is this a suitable choice?
 • *Sun is much larger than either Earth or Moon* [1]
 • *Represent Sun by largest ball* [1]
- (iv) Which ball should she use for the Moon? Explain your answer.
 • *Use a table tennis ball because Moon is much smaller than either the Sun or the Earth.* [2]
- (v) The diagram below shows how she places the balls that represent the Sun and the Earth. Draw cross on the diagram to show one possible position of the Moon. Label the cross **M** [1]



X MOON



- (v) List the planets in the table in order of increasing distance from the Sun
Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto [3]
- (vi) Name a planet that has no moon. *Mercury / Venus* [1]
- (vii) Name a planet with no atmosphere. *Mercury* [1]
- (viii) Name a planet with a solid surface. *Mercury / Venus / Earth / Mars* [1]
- (ix) Name a planet on which a probe has landed. *Mars / Venus* [1]

- 6 Write down in words in the box below the equation gives the relationship between weight, mass and the pull of gravity. [2]

$$\text{WEIGHT} = \text{MASS} \times \text{PULL OF GRAVITY}$$

- (a) In what units should mass be measured?

- *Kilograms* [1]

- (b) In what units should weight be measured?

- *Newtons* [1]

A newton meter is used to measure the pull of gravity on an object when it is on the earth's surface. The reading of the newton meter is 60 N. The pull of the Earth's gravity is 10 N/kg.

- (a) Calculate the mass of the object?

- *Weight of object = 60N*
- *60 = Mass of Object \times pull of earth's gravity*
- *Mass of Object = 60 / 10*
- *Mass = 6 kg* [2]

- (b) What will the newton meter read if it is used to measure the pull of gravity on the same object on the moon. (The pull of gravity on the earth's surface is 10 N/kg. On the moon it is 1.6 N/kg.)

- *Weight of object on Moon = 6 \times 1.6 = 9.6 Newtons* [2]

- (c) What happens to each of the following quantities when an object is taken from the earth to the moon. In each case give a reason for your answer.

- (i) its mass

- *Mass is unaffected by gravity*
- *Mass on Moon is the same as it is on Earth* [2]

- (ii) its weight

- *Weight is due to pull of gravity on object*
- *Weight on Moon is the less than it is on Earth* [2]

- (iii) its volume

- *Volume is unaffected by gravity*
- *Volume on Moon is the same as it is on Earth* [2]

- (iv) its density

- *Density depends on mass and volume*
- *Density on Moon is the same as it is on Earth* [2]