

# Physics paper 1 model answers

## Unit 1 Energy

**Q.1 Describe the energy changes when a person throws a ball upwards (4 marks)**

- The chemical energy stores (of food)
- Transfer to kinetic energy of the arm
- And the ball
- The ball gains gravitational potential energy as it moves upwards
- And loses kinetic energy
- The thermal energy store of the air around the moving ball increases

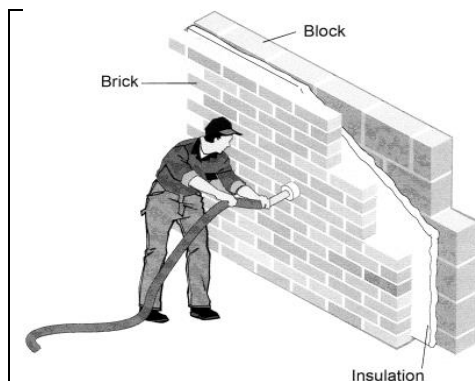
**Q.2 What is the specific heat capacity of a substance? (2 marks)**

- The amount of energy required to raise the temperature of **one kilogram** of a substance
- By one degree celcius

**Q.3 What is power? (2 marks)**

- The rate at which energy is transferred
- Or the rate at which work is done

**Q.4**



**Explain how the wall reduces unwanted energy transfers (3 marks)**

- The wall has two/three layers
- Cavity wall insulation/block/brick has a low thermal conductivity
- So less energy is transferred by conduction/rate of energy transfer is lower

**Q.5 The residents of a small island decide to use solar power and wind power to supply all their energy needs. Explain why this might not be a good idea (3 marks)**

- Solar power unreliable at night/in bad weather
- Wind power unreliable in calm weather
- Alternative reliable energy resource suggested

**Q.6**



**A new hydroelectric power plant is to be built. Outline and evaluate the important physical, economic and environmental factors to consider (6 marks)**

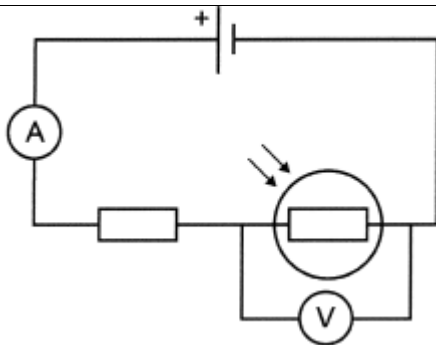
- Physical: Mountainous area with high rainfall
- Economic: expensive to build but provides free electricity/no fuel cost
- Environmental: flooding of river valley leading to habitat destruction OR creation of lake leading to new habitat development

**Q.7 The speed of wind hitting a wind turbine increases from 2.4 m/s to 4.8 m/s. Explain how the output kinetic energy of the turbine changes. (4 marks)**

- Two times greater because mass of air hitting turbine is twice as big
- and kinetic energy is directly proportional to mass
- Four times greater because speed of air is twice as big
- And kinetic energy is proportional to speed squared
- So eight times greater overall

## **Unit 2 Electricity**

**Q.1**



**Describe how the readings on both meters change when the environmental conditions change.**

- Resistance of LDR decreases
- When light intensity increases
- So overall resistance of circuit decreases
- So current in circuit increases (as  $V = IR$ )
- Lower resistance across LDR
- Means smaller share of potential difference (with fixed resistor)
- So reading on voltmeter decreases

**Q.2 Explain why a plastic kettle might not have an earth wire. (2 marks)**

- Outside/casing made from plastic
- So little chance of an electric shock

**Q.3 The current supplied by the mains and a battery is different. Explain how. (2 marks)**

- Battery current is direct and flows in one direction
- Mains current alternates and changes direction

**Q.4 Explain why touching the live wire of an appliance is dangerous when it is connected to the mains supply (4 marks)**

- Potential difference of live wire is 230 V
- Potential difference of person is 0 V
- Large difference between wire and person
- So charge/current passes through the person's body (into the Earth/ground)

**Q.5 Explain how the National Grid transfers energy efficiently. (4 marks)**

- Step-up transformers increase potential difference
- Which decreases current
- Which reduces power loss due to heating of transmission cables
- Then step-down transformers decrease potential difference and increase current
- To safer/more useful values for consumers

**Q.6 A rod and a duster are rubbed together. The rod becomes positively charged. Explain what has happened. (3 marks)**

- Electrons rub off the rod
- So excess of positive charges
- Electrons rub onto duster
- So it becomes negatively charge

**Q.7 Draw a positively charged metal sphere and four lines to show the electric field around it. (2 marks)**

- Four (approximately) equally spaced lines of force **touching the surface** of the sphere
- Arrows outwards on lines to show field direction

**Q.8 Explain why a charged object creates an electrical spark when it is brought close to a wall. (3 marks)**

- A potential difference between charged object/wall
- Means an electric current passes through the air into the wall
- To earth

### **Unit 3 Particle model of matter**

**Q.1 Use the particle model of matter to explain why ice floats on water (3 marks)**

- Particles are further apart in ice
- So lower density
- As particles are identical

**Q.2 Explain how the internal energy of water changes as it is heated from 20 °C to 30 °C (2 marks)**

- The (average) kinetic energy **of the particles** increases
- Which increases the energy

**Q.3 Explain how the internal energy of water changes as it is melting (2 marks)**

- The (average) potential energy **of the particles** increases
- Which increases the energy

**Q.4 Oxygen is heated up from – 200 °C to 30 °C. It changes state from solid to liquid to gas. Explain the changes in arrangement and movement of the particles as the oxygen changes state (6 marks)**

- Solid to liquid: particles change from regular to random arrangement, move freely instead of vibrate around a fixed position, still in close contact
- Liquid to gas: particles random arrangement, kinetic energy increases, far apart
- Explanation: Attractive forces between particles strongest in solid/negligible in gas, internal energy increasing due to increased potential energy for change of state, increased kinetic energy for increasing temperature

**Q.5 Define the specific heat capacity of a substance (2 marks)**

- The amount of energy required to raise the temperature of **1 kilogram** of a substance
- By 1 °C

**Q.6 Define the specific latent heat of fusion/vaporisation of a substance (2 marks)**

- The amount of energy required to change the state of **1 kilogram** of a substance
- With no change in temperature

**Q.7 The temperature of air in a container changes from 20 °C to 0 °C. The volume of the container stays the same. Explain how the pressure of the air in the container changes as the temperature decreases (3 marks)**

- Molecules have less kinetic energy
- So fewer collisions with wall of container
- So pressure decreases

**Q.8 A bicycle pump is used to inflate a tyre Explain why the internal energy of the air increases. (2 marks)**

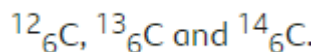
- Work is done on the air
- So the (average) kinetic energy/temperature of the particles increases

## Unit 4 Atomic structure

**Q.1 An atom emits electromagnetic radiation. Explain what has happened to an electron in the atom. (2 marks)**

- Moved closer to the nucleus
- To a lower energy level/electron shell

**Q.2 Describe differences in atomic structure for the isotopes of carbon:**



**(6 marks)**

- All have 6 protons in the nucleus
- Have 6, 7 and 8 neutrons in the nucleus
- All have 6 electrons; 2 electrons in first shell, 4 electrons in second shell

**Q.3 Describe key steps in the development of the atomic model (5 marks)**

- Originally atoms were thought to be tiny indivisible spheres
- Electrons were discovered
- The plum pudding model was proposed – atoms are a ball of positive charge with embedded electrons (still solid spheres)
- The alpha scattering experiment suggested atoms are mostly empty space (most particles passed through), with a small dense, charged nucleus (some particles deflected)
- Bohr said electrons orbited in shells
- Chadwick discovered the existence of neutrons about 20 years after protons and hence isotopes

**Q. 4 Compare the natures and properties of alpha particles, beta particles and gamma radiation. (6 marks)**

- Alpha: A helium nucleus/two protons, two neutrons; positively charged; low penetration e.g. stopped by paper; most ionising
- Beta: A (fast moving) electron; negatively charged; moderate penetration e.g. range of about 1 metre in air; moderately ionising
- Gamma: An electromagnetic wave; no charge; very penetrating e.g. stopped by several centimetres of lead; least ionising

**Q.5 Alpha particles, beta particles, gamma rays and neutrons can all be emitted by an unstable nucleus. What effect does the emission of each one of these have on the mass and charge of the nucleus? (6 marks)**

- Alpha particle two protons and two neutrons
- So mass decreases by four, charge decreases by two
- Beta particle formed when neutron turns into proton and electron
- So mass stays the same
- Charge increases by one
- Gamma ray is electromagnetic radiation
- So no change in mass or charge
- Neutron loss means mass decrease by one, charge stays the same

**Q.6 A scientist is analysing a radioactive isotope. She records both its activity and its count-rate. Compare activity and count-rate. (3 marks)**

- Activity is the rate at which a radioactive source decays
- Measured in becquerels
- Count-rate is the number of decays recorded every second (by a detector such as a Geiger-Muller tube)

**Q.7 Describe how ionising radiation could be used to detect a leak in an underground gas pipe. (4 marks)**

- Gamma radio-isotope as a source
- As it can penetrate through ground
- Increase in radiation detected
- Where there is a leak

**Q.8 Patients can be injected with a radioactive source for medical diagnosis. What are the ideal properties for a radioactive source for use in medical diagnosis? (4 marks)**

- Short half-life/half-life of a few hours as less damage to cells/tissues/organs
- Low ionising power as less damage to cells/tissues/organs
- High penetration as can be detected outside the body
- Emits gamma radiation

**Q.9 An ancient tree has been discovered in a peat bog. The tree has exactly  $1/16^{\text{th}}$  the percentage of carbon-14 compared to living trees. The half-life of carbon-14 is 5730 years. Determine how long the tree has been dead. (3 marks)**

- $1/16$  means four half-life events
- $4 \times 5730$
- 22,920 years

**Q.10 Compare the processes of radioactive contamination and irradiation. (3 marks)**

- Contamination is the unwanted presence of radioactive atoms in other materials
- Hazard due to decay of contaminating atoms and can cause other materials to become radioactive
- Irradiation exposes an object to nuclear radiation
- Does not cause the object to become radioactive

**Q.11 Describe the process of nuclear fission (4 marks)**

- A **neutron** is absorbed by a (large) **nucleus**
- The nucleus splits into two (smaller) nuclei
- Releasing gamma rays / energy
- And (two/three) neutrons

**Q.11 Describe the process of nuclear fusion (4 marks)**

- Two (light) **nuclei**
- Join together to form a heavier nucleus
- Some mass converted into energy of radiation