

Physics paper 2 model answers

Unit 5 Forces

Q.1 Describe the differences between a vector and scalar quantity (2 marks)

- A vector quantity has direction and magnitude
- A scalar quantity only has magnitude

Q.2 A plane has a horizontal velocity of 160 m/s and an upwards velocity of 20 m/s. Draw a diagram to scale on graph paper and work out the resultant velocity (4 marks)

- A suitable scale for the horizontal and vertical velocity e.g. 1 full square = 20 m/s so 8 squares for horizontal and 2 squares for vertical
- The vertical velocity starting at the end of the horizontal velocity
- A suitable magnitude determined – 183 m/s to 185 m/s
- A correct angle

Q.3 A satellite 1000 km above Earth experiences a gravitational field strength of 7.30 N/kg. Explain why this is less than on the surface of the Earth and estimate g at 500 km from Earth (2 marks)

- Gravitational attraction depends on closeness to (centre) of earth
- $(7.3 + 9.8)/2$
- 8.55 N/kg

Q.4 A plane is travelling at a steady speed. The forward force is provided by thrust. Complete a free body diagram from a point to show all the forces acting on the plane (4 marks)

- Air resistance/friction opposite to thrust
- And equal in size
- Weight and lift opposite
- And equal in size

Q.5 What is the moment of a force? What two quantities affect the moment of a force? (3 marks)

- The turning effect of a force
- Force size
- Distance from turning point

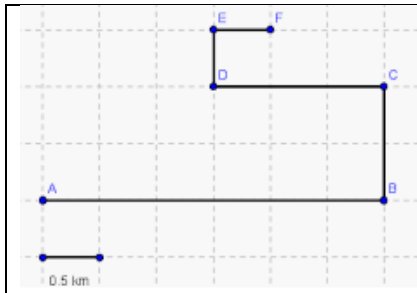
Q.6 Use the pressure of a liquid equation to explain the force of upthrust experienced by an object in a liquid. (4 marks)

- Pressure depends on height of liquid
- Height of liquid at top of object is less
- Therefore, pressure is less at the top
- Therefore, there is a resultant force upwards
- Equal to the weight of the displaced fluid.

Q.7 Explain why atmosphere pressure is lower at the top of a mountain compared to the bottom of a mountain (3 marks)

- Air molecules colliding with a surface create atmospheric pressure
- The number of air molecules decreases with height
- Therefore, less air at the top of the mountain
- So fewer collisions.

Q.8



The diagram represents a car journey.

Calculate

(a) the total distance travelled by the car between A and F

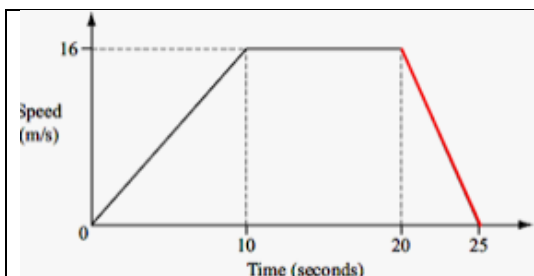
(b) the displacement of the car between A and F (4 marks)

- Distance = AB + BC + CD + DE + EF
- 6.5 km
- Displacement line drawn from A to F with arrow
- Allow magnitude 2.6 to 3.0 km

Q.9 Some students try to measure the speed of sound in air. One student has a starting pistol. Another student has a stopwatch. Describe how they can do this. (6 marks)

- Measure distance between the two students
- One fires the starting pistol
- Other starts stopwatch
- Use the equation distance = speed x time so speed = distance ÷ time
- Repeats
- Identify and discard anomalies
- Calculate a more accurate mean value

Q.10



Calculate the acceleration and distance travelled for each part of the journey. (6 marks)

- Acceleration = $y \text{ distance} \div x \text{ distance}$
- Acceleration = 1.6 m/s^2 , 0 m/s^2 , $(-)3.2 \text{ m/s}^2$ (3 correct for two marks, one correct for one mark)
- Attempt to calculate area under graph correctly
- 80 m, 160 m, 40 m (3 correct for two marks, one correct for one mark)

Q. 11 A sky diver jumps off a plane. After 30 seconds she opens her parachute. After 70 seconds she lands on the ground. Explain how the forces acting on her vary in this time (6 marks)

- Initially weight is bigger than air resistance/drag
- Accelerates
- Therefore, the force of air resistance becomes bigger
- Until it equals weight/terminal velocity
- Opening parachute increases air resistance
- So decelerates until again weight and air resistance are equal

Q.12 Explain the factors that affect the stopping distance of a car in an emergency stopping situation (6 marks)

- Stopping distance = thinking distance + braking distance
- Think distance factors: tiredness, distractions, drinking alcohol, taking drugs
- As reaction time increases
- Stopping distance factors: weather/road conditions, bald tyres, faulty brakes
- Less friction

Q.13 A moving skater collides with a stationary skater. Explain what happens to their movement after the collision. Use ideas about momentum (3 marks)

- Total momentum before collision = total momentum after collision
- Moving skater momentum decreases and therefore velocity decreases
- Stationary skater momentum/velocity increases

Q.14 Explain the effect the time spent in contact between a cricket bat and a cricket ball has on the distance the cricket ball travels (4 marks)

- Longer time of contact means greater change of momentum
- As mass of cricket ball is constant
- Velocity of cricket ball must increase
- So distance travelled increases

Q.15 Explain why seat belts/air cushions/crash helmets/safety mats reduce injuries (3 marks)

- Stopping distance increases
- So stopping time increases
- So force acting decreases.

Unit 6 Waves

Q.1 Describe the differences between longitudinal and transverse waves (2 marks)

- Longitudinal waves oscillations are parallel to transfer of energy
- Transverse waves oscillations are perpendicular to transfer of energy

Q.2 Explain why light refracts as it passes from air into glass at an angle (3 marks)

- Speed/velocity in of light in glass is lower
- So the edge of the wave entering the glass slows down
- But the part of the wave in air stays at the same speed
- So the wave changes direction

Q.3 Describe the characteristics of electromagnetic waves (3 marks)

- All are transverse waves
- Transfer energy from the wave source to a wave absorber
- Travel at the same velocity (300 000 000 m/s) through a vacuum
- Form a continuous spectrum

Q.4 Explain how the properties of X-rays make them suitable for medical imaging of bones. (2 marks)

- Pass through **soft** tissue/muscle
- Absorbed by bone

Q.5 Explain how the properties of microwaves make them suitable for satellite communication. (2 marks)

- Pass through the atmosphere
- From stations on Earth to satellites

Q.6 Describe how radio waves reaching a car aerial produce signals in the electrical circuit of the car radio (3 marks)

- Aerial absorbs radio waves/energy
- Making electrons vibrate (in the aerial)
- Creating an alternating current (in the aerial)
- With the same frequency as the radio waves

Q.7 Explain how X-rays/ gamma rays can be dangerous to humans. (3 marks)

- Ionising radiation
- Can penetrate body tissue
- Causes mutations of genes
- Leading to cancer

Q.8 Explain how ultrasound can be used to obtain an image of a foetus in its mother's womb (3 marks)

- Ultrasound waves are partly reflected when they pass between different tissue
- Time taken for reflections to reach a detector
- Can be used to work out how far away the boundary between the different tissue is

Q.9 Describe the differences between S-waves and P-waves produced by an earthquake. (3 marks)

- P-waves longitudinal, S-waves transverse
- P-waves faster speed/velocity
- P-waves can travel through solids and liquids, S-waves through solids only

Q.10 Describe the difference between specular and diffuse reflection. (3 marks)

- Reflection from a smooth surface causes specular reflection
- Reflection from a rough surface causes diffuse reflection
- Called scattering

Q.11 Some paper is coloured green. Explain why the colour of the paper is green (2 marks)

- The paper absorbs all other wavelengths of light shining on it
- Reflects green wavelengths

Q.12 Describe the properties of a perfect black body with respect to radiation. (2 marks)

- Absorbs all the radiation incident on it
- Does not reflect or transmit any radiation

Q.13 Describe and explain the factors that affect the temperature of the earth's surface and atmosphere. (6 marks)

- During daytime lots of energy is absorbed
- leading to local increase in temperature
- At night, more radiation is emitted than absorbed
- leading to local decrease in temperature
- Greenhouse gases in the atmosphere can absorb more radiation than they emit
- Leading to increase in temperature
- until emission equals absorption again

Unit 7 Magnetism and electromagnetism

Q.1 Describe the differences between a permanent and induced magnet (3 marks)

- A permanent magnet produces its own magnetic field
- An induced magnet becomes a magnet when placed in a magnetic field
- Induced magnet always causes a force of attraction

Q.2 Describe how to plot a magnetic field around a magnet using a compass (3 marks)

- Place the compass near a pole
- Mark the start and end of compass arrow
- Next place compass at the drawn end of arrow
- Repeat and use these to draw a line of force

Q.3 Describe how to make a solenoid with a current-carrying wire and the characteristics of the magnetic field produces (4 marks)

- Shape the wire into a loop
- Add an iron core
- Magnetic field is strong
- Magnetic field is uniform
- Magnetic field has same shape as a bar magnet

Q.4 Explain why a solenoid has a stronger magnetic field than an ordinary wire (2 marks)

- Field lines around each loop of wire
- Line up with each other increasing strength

Q5 Describe Fleming's left-hand rule (3 marks)

- Thumb represents force direction
- First finger represents magnetic field direction
- Second finger represents current direction

Q.6 Describe how a loudspeaker works (4 marks)

- Coil of wire around a permanent magnet
- Coil of wire attached to a diaphragm
- **Alternating** current in the coil of wire
- Causes the wire and therefore diaphragm to move forwards and backwards
- Creating sound waves

Q.7 Describe how a microphone works (4 marks)

- Coil of wire around a permanent magnet
- Coil of wire attached to a diaphragm
- Sound waves cause diaphragm to move forwards and backwards
- Causing coil of wire to move forwards and backwards in magnetic field
- Inducing an **alternating** current in the coil of wire

Q.8 Describe how a transformer works (4 marks)

- An alternating current in the primary coil
- Creates an alternating magnetic field around the primary coil
- Which transfers to the (soft) iron core
- Which induces an alternating potential difference in the secondary coil

Q.9 Describe how a motor works (5 marks)

- An alternating current in (the motor) coil of wire
- Creates an alternating magnetic field
- That is repelled by the motor's permanent magnet
- Each half turn the split ring commutator reverses the current direction
- Which reverses the magnetic field direction

Q.10 Describe how a generator works (4 marks)

- A coil of wire
- Rotates in a magnetic field
- Inducing an alternating current in the coil of wire
- Slip rings and brushes carry the induced current out

Unit 8 Space physics

Q.1 Describe the forces acting in the Sun that keep it stable (4 marks)

- Gravity pulls matter inwards
- Fusion reactions (of hydrogen into helium)
- Push the star outwards
- So forces are balanced

Q.2 Explain how elements up to iron are formed (3 marks)

- In a main sequence star
- Hydrogen is turned into helium (by nuclear fusion)
- In larger stars elements heavier than helium are fused

Q.3 Explain how elements heavier than iron are formed and distributed throughout the Universe (3 marks)

- Produced in a supernova
- Due to extreme heat/pressure
- Distributed by the outward explosion of the supernova

Q.4 A weather satellite orbits the Earth with a constant speed. Explain why it is constantly accelerating (3 marks)

- Acceleration is change in velocity (divided by time)
- Direction changes
- So velocity is changing

Q.5 Describe the Big Bang theory and the evidence that supports it (4 marks)

- Red-shift of light
- Shows that galaxies are moving away from us
- Farther away galaxies are moving away faster
- Universe started from an extremely small region
- That was very hot and dense

Q.6 Observations suggest that galaxies have less mass than they need to keep together. How and why have ideas about the mass of the Universe changed over time? (4 marks)

- New evidence
- Can't be explained by old model
- Dark matter proposed
- Observations helped to prove its existence