PHYSICS · Mark scheme and worked solutions

Physics Exam-Style Paper 1

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Question 1

[5 marks]

ANSWER

(a) — · must show Speed: scalar, Displacement: vector, Time: scalar, Velocity: vector

(b) (i) m/s, (ii) s · must show m/s, s

(c) Speed is the rate of change of distance and has no direction (scalar), while velocity is the rate of change of displacement and includes a direction (vector). · must show Speed: scalar, rate of distance, Velocity: vector, rate of displacement in a direction

MARKING POINTS

B1 (a) · 1 mark · Any two quantities correctly classified as scalar or vector.

B1 (a) · 1 mark · Any two other quantities correctly classified as scalar or vector.

B1 (b) · 1 mark · Correct SI units given for both speed (m/s) and time (s).

B1 (c) · 1 mark · States that speed is scalar and velocity is vector or describes the difference in directionality.

B1 (c) · 1 mark · Explains that velocity involves displacement/direction, while speed does not.

WORKED SOLUTION

Quantity	Type (Scalar or Vector)
Speed	Scalar
Displacement	Vector
Time	Scalar
Velocity	Vector

(i) The SI unit for speed is m/s. (ii) The SI unit for time is s.

Speed is a scalar quantity — it only has size (magnitude) and does not depend on direction. Velocity is a vector quantity — it has both magnitude and direction. For example, a car moving at 10 m/s north has a velocity of 10 m/s north but a speed of 10 m/s.

Question 2

[1 mark]

ANSWER

a = (v - u)/t

Also accept: a = (final velocity - initial velocity)/time taken

Common mistakes: Incorrectly rearranged formula

MARKING POINTS

B1 · 1 mark · Correct equation with symbols or full words (no rearrangement). Accept any equivalent.

WORKED SOLUTION

$$a = \frac{v - u}{t}$$

Question 3

[1 mark]

ANSWER

Correct option: A current that is always in the same direction with a constant value.

Common mistakes: Choosing AC properties for DC

MARKING POINTS

B1 · 1 mark · Selects the correct property of direct current.

WORKED SOLUTION

Direct current flows in one direction and has a constant value.

Question 4

[4 marks]

ANSWER

(a) n = sin(35°)/sin(22°) = 0.574/0.375 ≈ 1.53

(b) Refractive index n = sin i / sin r

(c) Light changes speed when entering a new medium, which bends its path and causes refraction.

MARKING POINTS

M1 (a) · 1 mark · Substitutes correctly into n = sin i / sin r. (follow-through)

A1 (a) · 1 mark · Correct answer for refractive index to 2 decimal places (1.53). (follow-through)

B1 (b) · 1 mark · States correct refractive index equation.

B1 (c) · 1 mark · Explains that refraction is due to change in speed as light enters a new medium.

WORKED SOLUTION

a) n = sin i / sin r = sin 35° / sin 22° = 0.574 / 0.375 = 1.53

b) The equation is: refractive index n = sin i / sin r

c) Refraction occurs because light travels at different speeds in different media. The change in speed bends its path at the boundary.

Question 5

[4 marks]

ANSWER

(a) Light hits the boundary inside the fibre at an angle greater than the critical angle, so it is totally internally reflected and stays inside the fibre. · must show Comparison to critical angle, Light does not escape; remains trapped

(b) Keyhole (less invasive) surgery is less stressful for patients or helps quicker recovery. Sound: ultrasound scans (imaging), or using sound to break up kidney stones. · must show Less invasive operations or quick recovery, Any valid medical use of sound waves

Also accept: Any other medical use of sound

Common mistakes: Not describing total internal reflection; Mixing up endoscope with ultrasound

MARKING POINTS

M1 (a) · 1 mark · States total internal reflection occurs at the boundary inside the fibre.

M2 (a) · 1 mark · Notes angle is greater than the critical angle or mentions trapping of light.

B1 (b) · 1 mark · States a correct reason why endoscope is better (e.g. less invasive, quick recovery, less scarring).

B2 (b) · 1 mark · States one valid medical use of sound (e.g., ultrasound scan, breaking kidney stones).

WORKED SOLUTION

a) In an optical fibre, the core has a higher refractive index than the outside. Light entering the fibre strikes the edge at an angle greater than the critical angle, resulting in total internal reflection. The light is reflected many times along the fibre without escaping.

b) Using endoscopes (with optical fibres) for keyhole surgery causes smaller wounds, reducing stress for patients and allowing quicker recovery. Sound waves are used for ultrasound scans to produce images inside the body, or to break up kidney stones.

Question 6

[2 marks]

ANSWER

Must show: Each application plus valid reason

Also accept: Telecommunications: transmits data quickly with low loss; Endoscopes: allows viewing inside the body because light travels through bends

Common mistakes: Listing medical use only; No explanation for why suitable

MARKING POINTS

B1 · 1 mark · Gives one correct application and valid reason

B2 · 1 mark · Gives a second correct application and valid reason

WORKED SOLUTION

- Telecommunications: fibres allow high-speed long-distance transmission of signals because light travels fast with little energy loss.
- Industrial inspection: fibres can be threaded through tight spaces in machinery to transmit images because they are flexible and transmit light around bends.

Question 7

[4 marks]

ANSWER

(a) Radiation

(b) Matt black (dull black) surface. Reason: matt black absorbs more radiation. · must show black, matt/dull, absorbs radiation

(c) The surface absorbs radiation, heats up, and transfers energy to the water by conduction. · must show water heated by contact

Common mistakes: Confusing radiation with conduction/convection

MARKING POINTS

B1 (a) · 1 mark · States 'radiation' (or 'infrared radiation').

B1 (b) · 1 mark · Gives correct surface: 'matt black' or 'dull black'.

B1 (b) · 1 mark · Correct reason: 'absorbs radiation' or similar.

B1 (c) · 1 mark · Explains heat transfers to water by conduction.

WORKED SOLUTION

a) The main process is radiation.

b) The best surface is matt black (dull black) because it absorbs the most radiation.

c) The absorbed energy heats the panel, which then heats the water by conduction.

Question 8

[4 marks]

ANSWER

(a) Hydroelectric or gas-fired power stations respond quickly; nuclear cannot respond quickly. · must show one that can respond quickly, one that cannot

(b) Hydroelectric power stations respond quickly because they can release water from reservoirs instantly to generate power. Nuclear power stations cannot start up quickly; it takes a long time to begin the nuclear reactions and heat the reactor core. · must show reason for fast response (immediate release/use of energy), reason for slow response (delayed process/ startup)

MARKING POINTS

B1 (a) · 1 mark · Correctly identifies a power station type that responds quickly (hydroelectric or gas-fired).

B2 (a) · 1 mark · Correctly identifies a type that cannot respond quickly (e.g., nuclear, coal-fired).

B3 (b) · 1 mark · Gives a reason for fast response (e.g., hydroelectric: water can be released instantly; gas: quick startup).

B4 (b) · 1 mark · Gives a reason for slow response (e.g., nuclear: long process to heat and start; coal: slow to heat boilers).

WORKED SOLUTION

a) Hydroelectric or gas-fired power stations can respond quickly. Nuclear power stations cannot respond quickly.

b) Hydroelectric power stations can quickly release water to drive turbines. Nuclear stations must heat the reactor, a slow process, so cannot respond quickly.

Question 9

[1 mark]

ANSWER

Releases greenhouse gases causing global warming.

Also accept: Global warming; Release of carbon dioxide; Causes acid rain

Common mistakes: Electricity is lost; Only heat is produced

MARKING POINTS

B1 · 1 mark · One valid problem such as global warming, acid rain or release of greenhouse gases.

WORKED SOLUTION
Burning fossil fuels releases carbon dioxide, a greenhouse gas, which causes global warming.

Question 10

[1 mark]

ANSWER
m^2

Also accept: metre squared; square metre

Common mistakes: Giving m^3; Giving cm^2

MARKING POINTS
A1 · 1 mark · Correct SI unit for area, m^2, given.

WORKED SOLUTION
The SI unit for area is square metre (m^2).

Question 11

[4 marks]

ANSWER
(a) When the magnet is moved into the coil, the ammeter shows a current.

(b) A current is induced because moving the magnet into the coil causes a change in the magnetic field cutting the coil. This 'cuts' the magnetic field lines and induces a voltage (and so a current) in the coil.

(c) Move the magnet faster; use a stronger magnet; use a coil with more turns. (any two)

Common mistakes: Saying current is always present even when magnet is stationary

MARKING POINTS
B1 (a) · 1 mark · States that a current appears on the ammeter when the magnet moves into the coil.

B2 (b) · 1 mark · Explains that moving the magnet causes a change in magnetic field in the coil.

B3 (b) · 1 mark · Correctly links magnetic field change to induced voltage and current.

B4 (c) · 1 mark · Names any two ways to increase the induced current: move faster, use a stronger magnet, or more turns in coil.

WORKED SOLUTION
a) The ammeter shows a current when the magnet enters the coil.

b) Moving the magnet changes the magnetic field through the coil, so magnetic field lines are 'cut' by the coil. This induces a voltage and causes a current to flow if the circuit is closed.

c) To increase the induced current, move the magnet faster, use a stronger magnet, or use a coil with more turns.

Question 12

[2 marks]

ANSWER
Magnetic field lines are drawn from north to south to show the direction a north pole would move in the field and the direction of the magnetic force.

Also accept: They show the direction of force on a north pole.; To show the direction of the magnetic field outside the magnet.

Common mistakes: States field goes from south to north.; Does not mention direction or force.

MARKING POINTS

B1 · 1 mark · States that this shows the direction of magnetic force.

B1 · 1 mark · Mentions that the direction is the way a north pole would move outside the magnet.

WORKED SOLUTION

Because outside a magnet, the field lines show the direction that a north pole would move. The magnetic field is defined by this direction, from north to south.

Question 13

[4 marks]

ANSWER

(a) Atoms of the same element with the same number of protons but different numbers of neutrons.

(b) Adding more neutrons can make a nucleus unstable. Carbon-14, with 8 neutrons, is less stable and radioactive, while carbon-12, with 6, is stable. · must show states neutron ratio/ number and how it affects stability

(c) Carbon-14 is used in radiocarbon dating/labelling in biology/archaeology.

Common mistakes: Confuses isotope with ion; States stability is only about proton count; Lists irrelevant uses

MARKING POINTS

B1 (a) · 1 mark · Gives correct definition of isotope.

B2 (b) · 1 mark · Links neutron number to nuclear stability or instability for carbon-14/ carbon-12.

B3 (b) · 1 mark · States carbon-14 is unstable/radioactive, carbon-12 is stable due to neutron number difference.

B4 (c) · 1 mark · States a correct use of a radioactive carbon isotope (e.g. radiocarbon dating).

WORKED SOLUTION

a) Isotopes are atoms of the same element (same proton number) with different numbers of neutrons.

b) The number of neutrons in a nucleus affects its stability. If there are too many (or too few) neutrons for the number of protons, the nucleus may become unstable and radioactive. Carbon-12, with 6 neutrons, is stable. Carbon-14, with 8 neutrons, is unstable and radioactive due to extra neutrons.

c) Carbon-14 can be used in radiocarbon dating to estimate the age of formerly living things.

Question 14

[4 marks]

ANSWER

(a) Gravity (gravitational force)

(b) N/kg

(c) Earth (gravity is stronger because its mass is more/field strength is higher) · must show comparison made, correct explanation (mass/field strength)

MARKING POINTS

B1 (a) · 1 mark · Gravity (or gravitational force) named correctly

B1 (b) · 1 mark · Unit N/kg stated correctly

B1 (c) · 1 mark · Correct answer: Earth

B1 (c) · 1 mark · Correct explanation: higher mass or higher gravitational field strength

WORKED SOLUTION

a) The force that keeps the satellite in orbit is gravity (gravitational force).

b) The unit of gravitational field strength is newton per kilogram (N/kg).

c) The strength of gravity is greater on Earth because Earth has more mass, so its gravitational field strength is higher than on the Moon.

Question 15

[1 mark]

ANSWER

metre (m)

Also accept: meter (m)

Common mistakes: centimetre; kilometre

MARKING POINTS

B1 · 1 mark · States the SI unit of length as metre (m).

WORKED SOLUTION

The SI unit for length is the metre (m).

Question 16

[5 marks]

ANSWER

(a) 27,000 kg m/s

(b) 10.8 m

(c) -5400 N (direction: opposite to motion) N

Common mistakes: Using wrong values for time or mixing reaction/braking phases

MARKING POINTS

A1 (a) · 1 mark · Momentum calculated as mass × velocity.

M1 (b) · 1 mark · States correct formula and substitutes values.

A2 (b) · 1 mark · Correct thinking distance value (10.8 m).

M2 (c) · 1 mark · Correct use of F = ma or F = change in momentum ÷ time with substitution. (follow-through)

A3 (c) · 1 mark · Correct value and sign of braking force (-5400 N). (follow-through)

WORKED SOLUTION

a) Momentum = mass × velocity = 1500 kg × 18 m/s = 27,000 kg m/s

b) Thinking distance = speed × reaction time = 18 m/s × 0.6 s = 10.8 m

c) Braking force:

First, change in velocity = 0 − 18 = -18 m/s

acceleration = (final − initial velocity)/time = (0 – 18)/5.0 = -3.6 m/s²

F = ma = 1500 × -3.6 = -5400 N (opposite to motion)

or

F = change in momentum / time = (0 – 27,000) / 5.0 = -5,400 N

Question 17

[3 marks]

ANSWER

(a) The force-extension graph for a rubber band is a curve, not a straight line. The extension does not increase proportionally with force. For a spring, the graph is straight with a constant slope at first. · must show Curve for rubber band, Straight line for spring, States difference is proportionality/linearity

(b) The rubber band does not have proportional extension; it is not directly proportional to force, so does not obey Hooke’s law. · must show States extension is not proportional to force

Common mistakes: Thinking rubber behaves same as metal spring

MARKING POINTS

B1 (a) · 1 mark · Mentions that rubber band graph is a curve/not straight line, not directly proportional.

B2 (a) · 1 mark · States spring graph is a straight line/proportional at first (for comparison).

B3 (b) · 1 mark · Gives reason: extension is not proportional to force for a rubber band.

WORKED SOLUTION

(a) The force-extension graph for a rubber band is a curve that is not a straight line. This means the extension does not increase evenly as more force is applied.

For a metal spring obeying Hooke's law, the force-extension graph is a straight line at first, showing proportion.

(b) A rubber band does not obey Hooke's law because the extension is not directly proportional to the force.

Question 18

[6 marks]

ANSWER

(a) power: watt (W), voltage: volt (V), current: ampere (A)

(b) 0.25 A

(c) A fuse melts when too much current flows; this breaks the circuit and prevents overheating or electric shock, protecting both the lamp and the user.

MARKING POINTS

B1 (a) · 1 mark · Correct SI unit for power (Watt) given.

B2 (a) · 1 mark · Correct SI units for voltage (Volt) and current (Ampere) given.

M1 (b) · 1 mark · Correctly uses P = I × V with rearrangement for I = P/V.

A1 (b) · 1 mark · Correct calculation of current (0.25 A). (follow-through)

B3 (c) · 1 mark · States that the fuse melts or breaks the circuit when excess current flows.

B4 (c) · 1 mark · Explains how this protects the lamp/user from overheating or shock.

WORKED SOLUTION

a. Power: watt (W), voltage: volt (V), current: ampere (A).

$$P = I \times V$$

b. Rearranging gives: I = P / V = 60 / 240 = 0.25 A

c. If a fault causes too much current, the fuse melts. This opens the circuit and stops the current, preventing the lamp from overheating or causing electric shock to the user.

Question 19

[5 marks]

ANSWER

(a) Double insulation means the casing and inner parts are both insulated, so no part accessible to the user can become live. This removes the need for an earth wire.

(b) 3.0 A

(c) 5 A fuse

(d) If too much current flows, the fuse melts and breaks the circuit: this prevents the appliance overheating, reduces risk of fire, and protects the user from electric shock.

MARKING POINTS

B1 (a) · 1 mark · Explains double insulation concept relating to safety.

B2 (a) · 1 mark · States why an earth wire is unnecessary with double insulation.

A1 (b) · 1 mark · Calculates correct current (3.0 A). (follow-through)

B3 (c) · 1 mark · Chooses correct size fuse (5 A).

B4 (d) · 1 mark · Gives two valid safety reasons for using a fuse.

WORKED SOLUTION

a) Double insulation means both the wires and the outer casing are made from insulating materials, so that the user cannot touch a live part even if a fault happens. Therefore, there is no need for an earth wire.

b) Current = Power / Voltage = 660 W / 220 V = 3.0 A

c) Choose the 5 A fuse, because 3.0 A is less than 5 A but above 3 A.

d) Fuses protect the hairdryer by breaking the circuit if there is too much current, preventing fire and electric shock.

Question 20

[1 mark]

ANSWER

Correct option: Electron

Common mistakes: Selecting proton or neutron

MARKING POINTS

B1 · 1 mark · Electron correctly selected.

WORKED SOLUTION

Electrons move to or from the rod during charging by friction.

Question 21

[4 marks]

ANSWER

(a) Electrical energy is transferred to thermal (heat) energy and to kinetic energy (if the hairdryer has a fan).

(b) A short circuit causes a large current to flow through the fuse, which then heats up and melts, breaking the circuit.

Must show: energy transfer terms, current/fuse relationship

Also accept: Electrical -> thermal, electrical -> kinetic (fan)

Common mistakes: Wrong order of energy, omitting fuse explanation

MARKING POINTS

B1 (a) · 1 mark · States electrical energy is converted to thermal (heat) energy.

B1 (a) · 1 mark · States electrical energy is converted to kinetic energy or vice versa.

M1 (b) · 1 mark · States that a large current flows if there is a short circuit.

A1 (b) · 1 mark · Explains the fuse melts/breaks the circuit to prevent damage or further hazard.

WORKED SOLUTION

a) Electrical energy is transferred to heat energy (to dry hair) and to kinetic energy (the fan inside the hairdryer spins to blow air).

b) If a short circuit develops, the current through the fuse increases greatly. The fuse wire heats up and melts, disconnecting the circuit and preventing further damage or hazard.

Question 22

[4 marks]

ANSWER

(a) BC is reflection; BD is refraction. · must show BC = reflected ray, BD = refracted ray

(b) Reflection is when the light bounces back from the surface at the same angle as it arrived (angle of incidence = angle of reflection). Refraction is when some light passes into the water and changes direction (bends) because its speed changes. · must show Reflection: light returns into air, angle of incidence = angle of reflection, Refraction: light enters water and bends due to change in speed

MARKING POINTS

B1 (a) · 1 mark · Identifies BC as reflection (reflected ray)

B1 (a) · 1 mark · Identifies BD as refraction (refracted ray)

B1 (b) · 2 marks · Describes reflection as light bouncing off at equal angle; describes refraction as light entering and changing direction (bending) because of speed change

WORKED SOLUTION

a) BC is the reflected ray; BD is the refracted ray.
b) In reflection, the light bounces off the surface at the same angle as it arrived. In refraction, the light passes into the new medium (water), changes speed, and bends.

Question 23

[1 mark]

ANSWER

Correct option: The vibrations are perpendicular to the direction of energy transfer.

Common mistakes: Choosing 'parallel' (longitudinal); Choosing 'no vibrations'; Choosing 'frequency is measured in metres'

MARKING POINTS

B1 · 1 mark · Chooses the correct option (perpendicular to direction of energy transfer).

WORKED SOLUTION

In a transverse wave, vibrations are at right angles (perpendicular) to the direction of energy transfer.

Question 24

[1 mark]

ANSWER

Correct option: Radiation

Common mistakes: Choosing conduction or convection

MARKING POINTS

B1 · 1 mark · Correct answer: Radiation.

WORKED SOLUTION

Radiation is the only method that can occur in a vacuum and does not need particles. Conduction and convection both require particles to transfer energy.

Question 25

[3 marks]

ANSWER

540 J (±0)

Common mistakes: Multiplying by wrong distance or force.; Not including unit.

MARKING POINTS

M1 (a) · 1 mark · Correct substitution into W=F×d

A1 (a) · 1 mark · Correct evaluation (540)

B1 (a) · 1 mark · Correct unit (J)

WORKED SOLUTION

Work done = force × distance

$$W = F \times d$$

$$W = 180\ \text{N} \times 3.0\ \text{m}$$

$$W = 540\ \text{J}$$

Question 26

[5 marks]

ANSWER

(a) — · must show measure mass using balance, find volume (ruler or displacement), use density formula

(b) 8000 kg/m³ · must show mass in kg, volume in m³, substitution into density formula

MARKING POINTS

B1 (a) · 1 mark · Mentions measuring mass with a balance.

B2 (a) · 1 mark · Describes finding volume (length × width × height or displacement).

B3 (a) · 1 mark · States use of density formula density = mass/volume.

M1 (b) · 1 mark · Converts mass and volume to SI units.

A1 (b) · 1 mark · Calculates and gives correct density in kg/m³ (accept values 7900–8100).

WORKED SOLUTION

a) Find the mass of the block using an electronic balance.

Find the volume by measuring its dimensions with a ruler (if regular) or by water displacement (if irregular).

Calculate density with: density = mass/volume.

b) Mass = 480 g = 0.48 kg; Volume = 60 cm³ = 0.00006 m³.

$$\rho = \frac{0.48}{0.00006} = 8000 \text{ kg/m}^3$$

Question 27

[5 marks]

ANSWER

(a) As the temperature decreases, the air particles move more slowly and collide with the walls of the bottle less forcefully and less often, so the pressure inside the bottle decreases. · must show slower particle movement, reduced frequency and/or force of collisions

(b) 94 kPa · must show correct Kelvin conversion, use of $\frac{p_1}{T_1} = \frac{p_2}{T_2}$

Common mistakes: Using Celsius instead of Kelvin; Forgetting to convert both temperatures

MARKING POINTS

B1 (a) · 1 mark · Mentions that particles move more slowly when cooled.

M1 (a) · 1 mark · Explains that less frequent or less forceful collisions mean lower pressure.

M2 (b) · 1 mark · Converts temperatures from °C to K.

A1 (b) · 1 mark · Uses $\frac{p_1}{T_1} = \frac{p_2}{T_2}$ and rearranges for p_2.

A2 (b) · 1 mark · Evaluates and gives final answer (94 kPa, 2 significant figures, with unit).

WORKED SOLUTION

(a) When the temperature decreases, the average speed of air particles decreases. They strike the bottle walls less often and with less force, resulting in a lower pressure.

(b) Convert both temperatures to Kelvin:

$$T_1 = 22 + 273 = 295\,K$$

$$T_2 = 4 + 273 = 277\,K$$

Use $\frac{p_1}{T_1} = \frac{p_2}{T_2}$:

$$p_2 = p_1 \frac{T_2}{T_1} = 100 \times \frac{277}{295} = 94\,\text{kPa}$$

Question 28

[1 mark]

ANSWER

p = F / A

Also accept: F = p × A; F = p * A; p = F ÷ A

Common mistakes: using mass instead of force; wrong symbols

MARKING POINTS

B1 · 1 mark · Correct equation with standard symbols

WORKED SOLUTION

The equation linking pressure (p), force (F), and area (A) is:

$$p = \frac{F}{A}$$

Question 29

[6 marks]

ANSWER

(a) — · must show Bar magnets with N facing S, field lines straight and parallel between them

(b) The field is the same strength and direction everywhere between the poles; field lines are parallel and evenly spaced.

(c) In cathode ray tubes / mass spectrometers / particle accelerators / MRI scanners / other scientific device with uniform field.

(d) The uniform region becomes smaller (or disappears) as the distance increases.

Must show: magnets placed with opposite poles facing

MARKING POINTS

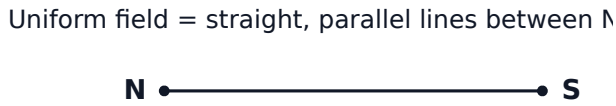
B3a (a) · 2 marks · Arrangement: magnets with N and S facing, uniform lines parallel and evenly spaced between (1). Clear labelling (1).

B3b (b) · 2 marks · Explains meaning of uniformity: strength and direction constant, lines parallel and evenly spaced (1 each).

B3c (c) · 1 mark · Correct scientific/technical use (1).

B3d (d) · 1 mark · Describes reduction or loss of uniform region as magnets are separated (1).

WORKED SOLUTION



Uniform field between bar magnets

a) (Student should draw two bar magnets with N and S poles facing each other closely, lines straight between them.)

b) The magnetic field is called "uniform" because its strength and direction are the same everywhere between the poles. The field lines are straight, parallel and evenly spaced.

c) Uniform magnetic fields are used in devices like cathode ray tubes or particle accelerators, to control the motion of charged particles.

d) As the magnets are moved further apart, the region of uniform field between them decreases in size and eventually disappears.

Question 30

[3 marks]

MARKING POINTS

M1 · 1 mark · Describes bringing a magnet close to the metal bar

B1 · 1 mark · States observation: if the magnet attracts the metal, it is magnetic

B1 · 1 mark · States control: if it does not attract, the bar is non-magnetic

WORKED SOLUTION

Bring a bar magnet near the unknown metal bar. If the bar is attracted to the magnet, then it is made of a magnetic material such as iron, steel, nickel, or cobalt. If there is no attraction, then it is non-magnetic.

Question 31

[5 marks]

ANSWER

(a) — · must show penetrating power allows sterilisation, penetration through thin film but low ionising for safety

(b) The becquerel is the number of decays per second. 5000 Bq is 5 kBq. · must show definition of Bq, conversion (5000 Bq = 5 kBq)

(c) Store radioactive sources in lead-lined containers / use tongs to handle. · must show one valid safety step

MARKING POINTS

M1 (a) · 1 mark · States that gamma rays are highly penetrating, so useful to sterilise or measure thickness.

M2 (a) · 1 mark · Mentions low ionising power or safety, or ability to pass through material for thickness measurement.

B1 (b) · 1 mark · Defines becquerel as decays per second.

A1 (b) · 1 mark · Correct conversion to 5 kBq.

B2 (c) · 1 mark · States a valid safety precaution (storage, handling, shielding).

WORKED SOLUTION

(a) Gamma rays have very high penetrating power, so they can pass through the equipment or film, making them suitable for sterilising inside packaging or measuring thickness since the rays are not easily blocked. Their low ionising power means they are less likely to damage material or harm workers nearby.

(b) The becquerel (Bq) measures the number of decays per second. 5000 Bq divided by 1000 gives 5 kBq.

(c) Radioactive sources should be stored in lead-lined containers to reduce exposure.

Question 32

[2 marks]

ANSWER

Examples: (1) Rocks and soil, especially granite, which may emit radon gas; (2) Cosmic rays from space.

Must show: Reference to environmental and cosmic sources

Also accept: Medical sources (if specifically natural: hospitals, if not accept environmental)

Common mistakes: Only giving one source; Giving nuclear power or weapons as natural sources

MARKING POINTS

B1 · 1 mark · Identifies a valid natural source (e.g., rock/soil, radon, cosmic rays).

B2 · 1 mark · Identifies a second valid, distinct source.

WORKED SOLUTION

Two natural sources are:
1. Radioactive materials in rocks or soil, such as granite releasing radon gas.
2. Cosmic rays from outer space entering Earth's atmosphere.

Question 33

[1 mark]

ANSWER

becquerel (Bq)

Also accept: Bq; becquerels

Common mistakes: curie; C

MARKING POINTS

B1 · 1 mark · Correct unit: becquerel (Bq)

WORKED SOLUTION

The unit of activity for a radioactive source is the becquerel (Bq).

Question 34

[5 marks]

ANSWER

(a) N/kg. Weight = mass × gravitational field strength, so W = m × g

(b) 600 N

(c) The blue star has a higher surface temperature because blue stars are hotter, while red stars are cooler. Colour indicates temperature.

MARKING POINTS

B1 (a) · 1 mark · Correct unit for gravitational field strength (N/kg)

M1 (a) · 1 mark · Correct weight formula given (W = m x g)

A1 (b) · 1 mark · Correct calculation of weight (600 N, with unit)

B2 (c) · 1 mark · States blue stars are hotter than red stars

E1 (c) · 1 mark · Links colour with temperature correctly (explanation)

WORKED SOLUTION

a) The unit of gravitational field strength is newton per kilogram (N/kg). The formula for weight is:

$$W = m \times g$$

b) For a mass of 150 kg and g = 4 N/kg:

$$W = 150 \times 4 = 600 \text{ N}$$

c) Blue stars have a higher surface temperature than red stars. The colour of a star is related to its temperature: blue is the hottest, then white/yellow, then red as the coolest.

Question 35

[3 marks]

ANSWER

(a) Planets orbit the Sun, while moons orbit planets.

(b) Asteroid (or comet, or dwarf planet accepted).

Also accept: asteroid, comet, dwarf planet accepted for b

Common mistakes: Confusing planet with moon

MARKING POINTS

B1 (a) · 2 marks · States planets orbit the Sun (1) and moons orbit planets (1).

B2 (b) · 1 mark · Names an asteroid, comet or dwarf planet (1).

WORKED SOLUTION

a) Planets orbit the Sun but moons orbit planets.

b) Asteroids are also found in the solar system (accept comet or dwarf planet).

Question 36

[3 marks]

ANSWER

(a) — · must show 1.20 m, 0.400 s; 0.85 m, 0.280 s

(b) metre (m) for length, second (s) for time · must show metre (m), second (s)

Common mistakes: confusing cm and m or ms and s; giving value but omitting the unit symbol

MARKING POINTS

M1 (a) · 1 mark · Correctly converts distance from cm to m and time from ms to s for at least one set.

A1 (a) · 1 mark · All conversions completed accurately, with correct units and symbols for both runs.

B1 (b) · 1 mark · States SI base unit and symbol for both length and time.

WORKED SOLUTION

a) Convert cm to m: divide by 100; convert ms to s: divide by 1000.

For first run: 120 cm = 1.20 m; 400 ms = 0.400 s

For second run: 85 cm = 0.85 m; 280 ms = 0.280 s

b) The SI base unit for length is metre (m), and for time is second (s).

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