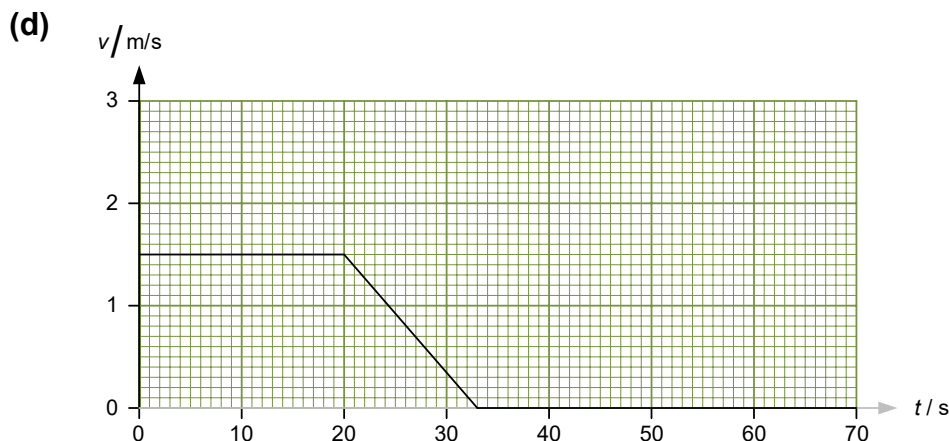


- 1 (a) 400 m [1]
- (b) $v = \text{gradient of s-t graph}$
 $v = 300/20$ [1]
 $= 15 \text{ m/s}$ [1]
- (c) Velocity is decreasing OR deceleration [1]
 Gradient is decreasing [1]



Label v-axis

Horizontal line at 15 m/s from 0s to 20s

Straight line or concave line or convex line from 20s to 33s from 15 m/s to 0 m/s

Horizontal line at 0 m/s from 33s to 70s

4 points – 3m

2 or 3 points – 2m

1 point – 1 m

[3]

- 2 (a) (i) $P = F/A$
 $P = 150/0.020$ [1]
 $P = 7500 \text{ N/m}^2$ [1]
- (ii) $7500 = \text{upward force}/0.016$ [1]
 upward force = 120 N [1]
- (b) (i) Vibration of particles transfer energy to neighbouring layer. Neighbouring layer vibrate faster and transfer to the next layer. [1]
 Free moving electrons transfer kinetic energy when colliding with particles that are vibrating slower. [1]
- (ii) Water is heated, becomes less dense and rises [1]
 Cooler water, which is denser, sinks to take its place. [1]

- 3 (a) Resultant force = 0 N [1]
 Resultant moment = 0 Nm
 OR
 Total clockwise moment about a pivot is equal to total clockwise moment about the same pivot. [1]
- (b) $W = (12)(10) = 120 \text{ N}$ [1]

$$(F)(0.50) = [(3.00/2)-0.50](120) \quad [1]$$

$$F = 240 \text{ N} \quad [1]$$

$$(c) \quad P = \frac{(240)(0.20)}{1.5} \text{ (ecf)} \quad [1]$$

$$P = 32 \text{ W} \quad [1]$$

4 (a) Oscillation of particles is parallel / same direction as direction of wave travel [1]

(b) Difference: frequency of ultrasound is greater than 20000 Hz but audible sound falls between 20 Hz and 20000 Hz. (accept: less than 20000 Hz) [1]

Similarity: both require medium to transfer OR both transfer energy
(reject longitudinal wave – given in (a)) [1]

$$(c) \quad v = 2d/t$$

$$1500 = (2)(d)/0.40 \quad [1]$$

$$d = 300 \text{ m} \quad [1]$$

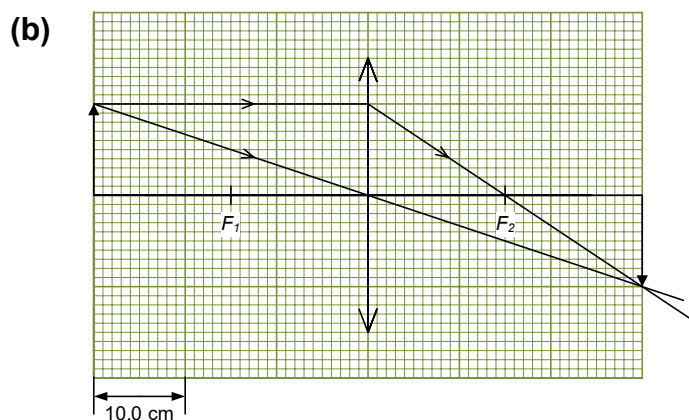
$$(d) \quad v = f\lambda$$

$$1500 = (40000)(\lambda) \quad [1]$$

$$\lambda = 0.0375 \text{ m} \quad [1]$$

(e) Prenatal scanning OR detect cracks in metals OR clean delicate objects OR medical scanning of soft tissue [1]

5 (a) All rays parallel to principal axis converging to a point after passing through the convex lens. [1]



Arrow on every light ray

One ray parallel to principal axis

One ray through F

One ray through optical centre

Full image labelled "I" and inverted arrow at 2F

5 points – 3m

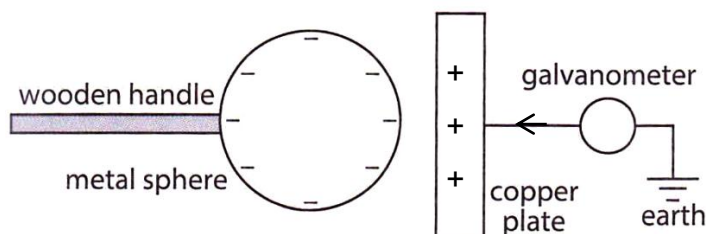
3 to 4 points – 2m

2 points – 1m [3]

(c) Size enlarge [1]

Distance increases [1]

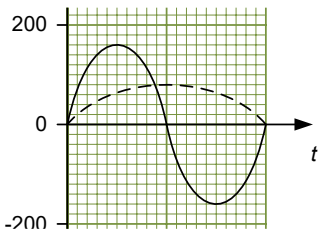
- 6 (a) (i)** Current in a conductor is directly proportional to the potential difference across it provided the external (or physical) conditions remain constant. [1]
- (ii)** R. straight line graph passing through the origin. [1]
- (iii)** $R = V/I$
- $R = 6.0/0.42$ [1]
- $R = 14.286 \Omega$
- $R = 14.3 \Omega$ (3 sf) OR 14Ω (2 sf) [1]
- (b) (i)** Effective resistance decreases [1]
- Current increases. [1]
- (ii)** Under dark condition, potential difference across LDR is higher than across 50Ω resistor. When the potential difference exceeds 10 V, the lamp lights up. [1]
- Under bright condition, potential difference across LDR is lower than across 50Ω resistor. When the potential difference falls below 10 V, the lamp switches off. [1]
- 7 (a) (i)** up [1]
- (ii) 1** Up [1]
- 2** When AB is nearer to north pole, it will turn towards South pole. But when AB is nearer to south pole, it will turn towards North pole. It reaches a state where the resultant force becomes zero and the coil remains vertical
- OR
- Direction of current is not reversed every half rotation so it cannot rotate continuously
- OR
- Force on AB is always upwards and force on CD is always downwards regardless of orientation. [1]
- (b) (i)** Like charges repel [1]
- Negative charges nearer to negatively charged metal sphere are repelled to the right side into the earth, forming the momentary deflection in the galvanometer. [1]
- (ii) (iii)**



At least 3 positive charges on rod – 1m

Current from galvanometer to copper plate – 1m

- 8 (a)** 15 protons and 17 neutrons [1]
- (b)** $\{u = 32, v = 16\} - 1m$ $\{x = 0, y = -1\} - 1m$ [2]

- (c) (i) Radiation in an environment where no radioactive source has been deliberately introduced. [1]
- (ii) *count rate:* $640 \rightarrow 320 \rightarrow 160 \rightarrow 80$
days: $0 \rightarrow 14 \rightarrow 28 \rightarrow 42$ [1]
 Time taken = 42 days [1]
- (d) treat cancer [1]
 Does not remain in body for too long [1]
- 9 (a) Gravitational field strength is equal to initial acceleration [1]
 Air resistance is zero. OR the only force is the weight. [1]
- (b) $W - f = ma$
 $(2)(12) - 4 = (2)(a)$ [1]
 $a = 10 \text{ m/s}^2$ [1]
- (c) Weight in L is larger than weight in K [1]
 Lower terminal velocity in L implies greater air resistance in L [1]
 L has denser atmosphere OR L has greater air density [1]
- (d) (i) 8.0 N [1]
- (ii) Energy in gravitational potential store of probe is transferred mechanically to energy in internal store of the probe.
 mechanically – 1m
 gravitational potential store, internal store – 1m [2]
- 10 (a) (i) volume = $(\pi)(40)^2(12) = 60320 \text{ m}^3 = 60300 \text{ m}^3$ (3 sf) OR 60000 m^3 (2sf) [1]
- (ii) $\rho = \frac{m}{V}$
 $1.2 = \frac{m}{60320}$
 $m = 72384 \text{ kg}$ [1]
 $E_k = \frac{1}{2} mv^2$
 $E_k = \frac{1}{2} (72384)(12)^2$ [1]
 $E_k = 5.212 \times 10^6 \text{ J}$
 $E_k = 5.21 \times 10^6 \text{ J}$ (3 sf) OR $5.2 \times 10^6 \text{ J}$ (2 sf) [1]
- (b) (i) 160 V [1]
 Rate of change of magnetic flux linkage is the maximum. [1]
- (ii)  [2]
 1m – peak at 80 V.
 1m – double period.
- (c) Low current, less energy loss along transmission lines [1]
- (d) Disadvantage: depends on weather / kills birds that strike the windmill / use a lot of space [1]

- 11 (a)** Control amount of current flowing through OR control resistance of circuit. [1]
- (b)** Particles vibrate slower at 20 °C than at 60 °C. [1]
- (c)** $rate = \frac{68 - 20}{300} = 0.16 \text{ } ^\circ\text{C/s}$ [1]
- (d) (i)** $Pt = mc\Delta\theta$
- $(50)(300) = (0.80)(c)(48)$ [1]
- $c = 391 \text{ J/(kg } ^\circ\text{C)}$ (3 sf) or $c = 390 \text{ J/(kg } ^\circ\text{C)}$ (2 sf) [1]
- (ii)** Specific heat capacity refers to the energy needed to change one unit mass by one Kelvin but heat capacity refers to the energy needed to change a substance by one Kelvin. [1]
- (e) (i)** More energy needed to raise 1 kg of substance by 1 °C with same heater. Therefore temperature rise is smaller [1]
- Gradient is gentler [1]
- (ii)** Different substance has different particles [1]
- Energy needed to change kinetic energy of particles in second metal is greater than energy needed to change kinetic energy of particles in first metal for the same mass. [1]
- 0m if students use definition.*