Physics 5054/21, Paper 2 Theory, May/June 2026

Apollo mark scheme (AI-generated). Maximum mark: 80

This is not an official Cambridge document. Apollo generated it with AI from the marking points in the published scheme for this paper, because the published file's Marks column shows a single mark per part. Every marking point is given its own row with a mark code so that each part totals the marks shown in the question paper.

The marking points and the accept / ignore / reject guidance come from the published scheme. Lines marked *Apollo note* are Apollo additions: worked checks of numerical answers and corrections of evident slips.

Question totals: Q1 [8], Q2 [8], Q3 [10], Q4 [10], Q5 [9], Q6 [9], Q7 [8], Q8 [10], Q9 [8].

Mark codes and abbreviations

B1	independent mark	**B2**	two independent marks from a list (one per point)
C1	compensatory mark: implied by a correct final answer	**A1**	answer mark
A	accept the response	**I**	ignore the response
not	reject the response	**ecf**	error carried forward
bod	benefit of the doubt	**/**	alternative responses for the same marking point
( )	words in brackets are not needed for the mark	**___**	underlined words must be present
TV	too vague	**WTTE**	words to that effect

Question	Answer	Marks	Guidance
1(a)(i)	same change in speed / velocity in same time / unit time / in 1 s	**B1**	**A** any named time period; same increase in speed over time; straight line on speed–time graph; rate of change in velocity is constant; increasing speed at a constant rate **I** formula alone; speed increases steadily; accelerates at a constant rate
1(a)(ii)	(a =) $v \div t$ in any form	**C1**	
	0.8 (m / s^2)	**A1**	*Apollo note: $a = 16 \div 20 = 0.80$ m / s^2*
1(b)	straight line from (0, 0) to (20, 16)	**B1**	**A** within ½ square
	horizontal line from (20, 16) to (100, 16)	**B1**	penalise wrong value plotted for 16 once only
	straight line from (100, 16) with a decrease of 6 m / s	**B1**	**ecf** from a misplotted value of speed or time at one point each time *Apollo note: decrease = 0.30 × 20 = 6.0 m / s, so the line ends at (120, 10)*
1(c)	*acceleration / t = 0 to 20 (s):* forwards force larger than backwards force	**B1**	throughout: **A** driving force / thrust for forwards force **A** resistive force / force from brakes / air resistance / resistance with road for backwards force; mention of resultant force forwards **bod** force of acceleration is forwards force *Apollo note: the published scheme prints "t = 20 to 100 (s)" for the acceleration stage; the bus accelerates from t = 0 to 20 s (zero acceleration from 20 to 100 s), so the stage is labelled 0 to 20 s here*
	deceleration / t = 100 (s) onwards: resistive force acts alone **or** backwards force > forwards force	**B1**	**I** other regions / just 'forces are unbalanced' / 'resultant force acts'; just 'backwards force increases'
Apollo AI-generated mark scheme – not an official Cambridge document			Question 1 **[Total: 8]**

Question	Answer	Marks	Guidance
2(a)(i)	gravitational (potential) energy to kinetic energy	**B1**	**A** GPE to KE at Q; a change is needed
	(kinetic energy) to internal energy	**B1**	**A** KE to heat energy / thermal energy **I** back to GPE at bottom of fall (in splashes); energy to sound
2(a)(ii)	lower / slower / smaller / less for both temperature and average speed	**B1**	**A** colder
2(b)(i)	(KE =) $\frac{1}{2}mv^2$ algebraic	**C1**	
	$\frac{1}{2} \times 2.5 \times 8.0^2$ numerical	**C1**	award of this mark also earns the 1st mark
	80 (J)	**A1**	**not** 2500
2(b)(ii)	GPE **or** KE from **(b)(i)** = *mgh* numerical or algebraic	**C1**	**A** use of distance = $v^2 / 2g$ *Apollo note: the published scheme cites "(a)(iii)"; the kinetic energy comes from (b)(i), so* **ecf** *from (b)(i)*
	3.3 (m)	**A1**	3.265; **accept** 3.2 if 10 N / kg used *Apollo note: h = 80 ÷ (2.5 × 9.8) = 3.27 m*
Apollo AI-generated mark scheme – not an official Cambridge document			Question 2 **[Total: 8]**

Question	Answer	Marks	Guidance
3(a)(i)	(F =) pA numerical or algebraic	**C1**	
	12 N	**A1**	*Apollo note: $1.0 \times 10^5 \times 1.2 \times 10^{-4} = 12$ N*
3(a)(ii)	(air) pressure / force outside syringe = (air) pressure / force inside syringe **or** atmospheric pressure (outside syringe) pushes to the right / inwards / produces zero resultant force	**B1**	**I** pressure in syringe less than atmospheric pressure; comments about friction
3(a)(iii)	2.4×10^{-23}	**B1**	**A** 2.35, 2.3×10^{-23} **I** formula mv *Apollo note: $4.7 \times 10^{-26} \times 500 = 2.35 \times 10^{-23}$*
	kg m / s **or** N s	**B1**	**not** kg / m / s
3(a)(iv)	many particles in gas	**B1**	**A** atoms and molecules for particles; large number of collisions **I** no. of particles increase
	many hits per second / many hits in unit time / frequent hits	**B1**	**A** high(er) frequency of collisions; hit often **I** many hits etc. <u>on each other</u>; hit rapidly
3(b)	$p_1V_1 = p_2V_2$ numerical or algebraic	**C1**	
	$1 \times 10^5 \times 90 = p \times 50$	**C1**	numerical calculation could involve 40
	1.8×10^5 (Pa)	**A1**	2.2(5) $\times 10^5$ gets 2 marks *Apollo note: new volume = 90 − 40 = 50 cm^3; $p = 1.0 \times 10^5 \times 90 \div 50 = 1.8 \times 10^5$ Pa*
Apollo AI-generated mark scheme – not an official Cambridge document		Question 3	**[Total: 10]**

Question	Answer	Marks	Guidance
4(a)	Any **two** from: • can reflect / diffract / refract • travel through a vacuum / do not require a medium • transverse • are oscillating electric and magnetic fields • travel at the speed of light / same speed (in vacuum / air)	**B2**	1 mark for each point, max. 2 **I** no mass, no charge
4(b)	Any **two** from: • X-rays pass through the spaces **or** X-rays make the image darker / go black • (most / all) X-rays absorbed by / cannot penetrate the teeth • X-rays partially absorbed by the tissue / some pass through tissue	**B2**	1 mark for each point, max. 2 X-rays reflected max. 1 mark
4(c)(i)	oscillation / vibration	**B1**	**A** backwards and forwards or any clear oscillation, e.g. up and down; left and right; to and fro
	longitudinal **or** backwards and forwards **or** in the direction of the sound / parallel to the direction of travel of the wave **or** formation of compressions and rarefactions	**B1**	**A** ultrasound longitudinal **I** left and right, up and down
4(c)(ii)	(d =) vt algebraic or numerical	**C1**	**A** $\frac{1}{2}vt$; $\frac{1}{2} \times 8.0 \times 10^{-5} \times 1500$; 0.12 m; 12 cm
	0.06(0) m	**A1**	*Apollo note: the time is for the journey there and back: $d = \frac{1}{2} \times 1500 \times 8.0 \times 10^{-5} = 0.060$ m*
4(c)(iii)	(wavelength) decreases (in air)	**B1**	
	$v = f\lambda$ **and** frequency the same **or** each (complete) wave travels less distance (before the next arrives)	**B1**	**A** frequency the same **and** $v \propto \lambda$
Apollo AI-generated mark scheme – not an official Cambridge document		Question 4	**[Total: 10]**

Question	Answer	Marks	Guidance
5(a)(i)	move the bar (up and down continuously)	**B1**	**A** left and right; vibrate the bar; use bar to disturb water / bar hits water / shake the bar **I** put bar in water; move support; bar touches water; just 'stretch and release bands'
5(a)(ii)	use a (barrier with a) slit **or** (two) obstacles with a gap **or** the edge of a barrier (in the water) **or** waves bend around an obstacle	**B1**	**I** just 'create a hole'; have a gap; original wooden bar acts as obstacle **NB** must mention edge or gap or slit or similar
5(a)(iii)	(count) the number of oscillations / crests (passing a point) in a (measured) time **or** measure the time for a given number of waves **or** measure / find the time for one wave / measure or find the period	**B1**	**A** (count) number of waves in any time; time for one wave to be formed **I** $v = f\lambda$ unless wavelength and speed measurement described; just 'find period'
	divide the number of waves by the time (in seconds) **or** count the number of crests / wavefronts passing / oscillations in one second **or** 1 / time for one wave (the period)	**B1**	1 mark for 'count no. of waves in unit time' **just** count no. of waves / oscillations in one second / unit time 2 marks if no measurement made, e.g. '*f* is number of waves / oscillations per second / unit time', 1 mark
5(b)(i)	amplitude marked from top **or** bottom of wave to the middle (undisturbed surface)	**B1**	**A** at other point if clear
5(b)(ii)	(T =) 1 / f **or** 0.5(0) (s) seen for time	**C1**	
	0.25 (s)	**A1**	*Apollo note: T = 1 ÷ 2.0 = 0.50 s; top to bottom is half an oscillation, ½ × 0.50 = 0.25 s*
5(b)(iii)	increases as it moves down (to the middle)	**B1**	**A** increases top to bottom for this mark; needs to indicate increase while moving down / falling; just 'increases' TV
	moving fastest in the middle **or** decelerates (speed decreases) after middle / near bottom **or** stops at bottom	**B1**	
Apollo AI-generated mark scheme – not an official Cambridge document			Question 5 **[Total: 9]**

Question	Answer	Marks	Guidance
6(a)(i)	(I =) P / V in any form	**C1**	
	current in lamp = 3.3 (A)	**A1**	3.33; penalise s.f. / fractions only once *Apollo note: 40 ÷ 12 = 3.33 A*
	current in battery twice that in lamp / 6.7 **or** 6.6 (A)	**B1**	*Apollo note: lamps in parallel: 2 × 3.33 = 6.67 A*
6(a)(ii)	(R =) V / I in any form **or** (R =) P / I^2	**C1**	**ecf** 12 / current in battery but accept current in lamp for 1st mark **accept** (R =) V^2 / P
	1.8 (Ω)	**A1**	*Apollo note: 12 ÷ 6.67 = 1.8 Ω (each lamp 3.6 Ω; two in parallel give 1.8 Ω)*
6(a)(iii)	as the temperature (of the filament) rise(s) / lamp heats up	**B1**	**A** lamp releases heat **I** heat lost / wires get hot
	the resistance (of the filament / lamp) increases	**B1**	**I** resistance is high (must be an increase)
6(b)	hot gas (near filament) / less dense particles rise **or** convection occurs	**B1**	**A** hot particles rise / hot metal atoms rise
	hot gas less dense	**B1**	**I** hot particles / metal atoms less dense
Apollo AI-generated mark scheme – not an official Cambridge document			Question 6 **[Total: 9]**

Question	Answer	Marks	Guidance
7(a)	current <u>in coil / 12 V battery / solenoid / switch</u>	**B1**	**not** alternating current; current / emf in core **I** current in circuit; **accept** current <u>around</u> core (i.e. in coil) if clear not in core
	core (and armature) becomes magnetised / an electromagnet	**B1**	**I** core becomes magnetic; solenoid magnetised
	(unlike poles on core) attracts <u>armature</u> (and the iron armature moves)	**B1**	**A** pulls armature to core
7(b)	magnetism stops **or** magnetic force stops **or** iron is a temporary magnet	**B1**	**I** attraction stops; **accept** core / iron demagnetised
	springy metal / gravity pushes armature **or** contacts down	**B1**	
7(c)	steel is a permanent magnet	**B1**	**A** steel not a temporary magnet / does not (easily) lose magnetism / hard to demagnetise **I** steel stays magnetised for longer / takes time to lose; steel is a hard magnetic material
	the relay / heater would stay switched on / contacts still touch	**B1**	**A** core would stay attracted / close to armature
7(d)	(relay in **Figure 7.1**) uses low voltage / low current (near switch / hand) / provides insulation (from 240 V supply) **or Figure 7.2** involves (possible) contact with high voltage / high current	**B1**	**A** reverse arguments **I** no fuse; 240 V blows up heater; to avoid shock
Apollo AI-generated mark scheme – not an official Cambridge document			Question 7 **[Total: 8]**

Question	Answer	Marks	Guidance
8(a)(i)	Any **one** from: • cancer • cell death • mutations • radiation sickness	**B1**	**I** just 'death'; skin irritations; cell damage; burns **A** any form of cancer, e.g. melanoma
8(a)(ii)	(alpha particle) attracts electron (in atom)	**B1**	alpha particle attracts electron **from** atom gets 2
	atom loses an electron	**B1**	**not** emission of alpha particle from atom causing loss of 2 electrons; reduces or increases proton no. of atom; reacts / bonds with atoms
8(a)(iii)	Any **one** from: • reduce exposure time • increase distance • use of shielding	**B1**	**I** safety hazard sign; thick material **A** use tongs; use robots; avoid direct contact; limit exposure **A** lead (apron / suit), 1 m concrete **I** wear protective gear / gloves / hazmat suit; bury in ground; avoid overexposure
8(b)(i)	$^{4}_{2}\mathrm{He}$ (nucleon number 4, proton number 2)	**B1**	
8(b)(ii)	proton number **or** atomic number (*Z*) increases by 1	**B1**	**A** neutron changes into a proton and electron for both marks **I** electrons
	neutron number decreases by 1 **or** mass number / nucleon number (*A*) remains the same	**B1**	
8(c)	alpha particles: no tick in any column	**B1**	**No mark** if candidates have placed no tick anywhere in the table (i.e. have not answered the question)
	beta particles: tick, tick, blank	**B1**	*Apollo note: beta passes through 20 cm of air and thin paper but is stopped by 5 mm of metal*
	gamma radiation: (tick), tick, tick	**B1**	*Apollo note: alpha has a range of only a few cm in air and is stopped by paper; gamma passes through all three*
Apollo AI-generated mark scheme – not an official Cambridge document		Question 8	**[Total: 10]**

Question	Answer	Marks	Guidance
9(a)(i)	planets take different times to orbit the Sun / move at different (angular) speeds	**B1**	**A** different speeds / rates around Sun **not** Venus has larger orbital period than Earth; Earth moves faster than Venus
	sometimes they are on the same side / sometimes on different sides of the Sun / do not always align **or** WTTE	**B1**	**A** the orbits are elliptical / not circular; **accept** from diagrams with planets labelled
9(a)(ii)	4(.0)	**B1**	**A** 4(.0) × 10^7 with extra × 10^7 km *Apollo note: 1.5 × 10^8 − 1.1 × 10^8 = 0.4 × 10^8 = 4.0 × 10^7 km*
9(b)	incorrect **and** because Mars and Venus, **or** Mars and Earth, **or** Saturn and Jupiter do not follow the relationship	**B1**	only one pair from Mars / Venus **or** Mars / Earth **or** Saturn / Jupiter needs to be mentioned **or** Jupiter has largest mass but not the largest period
	Mars has less mass than Earth or Venus and a longer orbital period **or** Jupiter has larger mass than Saturn but a smaller orbital period	**B1**	**A** values quoted **A** one of the pairs from first mark explained
9(c)	(V =) M / ρ (mass ÷ density) in any form	**C1**	
	1.1 × 10^{21} (m^3)	**A1**	1.0909 × 10^{21} *Apollo note: 6.0 × 10^{24} ÷ 5500 = 1.09 × 10^{21} m^3*
9(d)	orbital speed = 2πR / T	**B1**	
Apollo AI-generated mark scheme – not an official Cambridge document			Question 9 **[Total: 8]**