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Cambridge IGCSE™

PHYSICS **0625/41**

Paper 4 Extended Theory **May/June 2023**

MARK SCHEME

Maximum Mark: 80

Published

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[Turn over

Question	Answer	Marks
1(a)(i)	(magnitude of velocity =) 0.90 m / s	**A2**
	use of Pythagoras' theorem e.g. $a^2 + b^2 = c^2$ OR (speed =) $\sqrt{(0.54^2 + 0.72^2)}$ **OR** correct vector triangle or rectangle drawn	C1
	(direction of velocity =) 53° (to riverbank)	**A2**
	use of trigonometry to find angle e.g. $\tan\theta = 0.72 / 0.54$ **OR** (only) angle with horizontal identified on the diagram	C1
1(a)(ii)	(distance =) 81 m	**A3**
	$v = s / t$ **OR** (s =) vt **OR** (s =) $0.9(0) \times 90$	C1
	(time =) 1.5×60 (= 90) **OR** (time =) 90	C1
1(b)	friction (of water backwards) **OR** resistance (on swimmer backwards)	**B1**
	(friction / resistance) balances forward force **OR** (there is) no resultant force	**B1**

Question	Answer	Marks
2(a)(i)	(speed =) 38 m / s	**A2**
	$a = \Delta v / \Delta t$ **OR** (Δv =) $a\Delta t$ **OR** (Δv =) 7.2×5.3	C1
2(a)(ii)	(resultant force =) 1 700 N	**A2**
	$F = ma$ **OR** (F =) ma **OR** (F =) 240×7.2	C1
2(b)(i)	(vector) has direction (as well as magnitude) **OR** scalar does not have direction	**B1**

Question	Answer	Marks
2(b)(ii)	(velocity) changes (as direction of motion changes) **OR** direction (of velocity) changes	**B1**
2(b)(iii)	any **two** from: • because there is an acceleration / change in velocity / change in direction / change in momentum (which needs a resultant force) • motorcyclist accelerates / changes momentum (because velocity / direction changes) • (resultant) force is perpendicular to the motion (of the motorcycle) **OR** $a \propto F$	**B2**

Question	Answer	Marks
3(a)	heated / hot(ter) / warm(er) air is less dense **OR** cool(er) air is more dense	**B1**
	heated / hot(ter) / warm(er) air rises (to ceiling displacing cooler air) **OR** cool(er) air falls (displaced by warm(er) air)	**B1**
3(b)(i)	speed / velocity (of particles) increases **OR** (they) move faster	**B1**
3(b)(ii)	(higher temperature means) particles collide (with rubber) harder / with more force / with greater momentum (change)	**B1**
	(larger volume means) particles collide (with rubber) less frequently **OR** (larger volume means) larger (surface) area (for particle collisions)	**B1**
	effect of larger volume cancels effect of increased temperature / owtte **OR** the effect of larger area cancels the effect of larger force / owtte **OR** $P = F / A$ so the two changes cancel each other / owtte	**B1**

Question	Answer	Marks
4(a)(i)	$c = (\Delta)E / m\Delta\theta$ **OR** $(\Delta E =) mc\Delta\theta$	**B1**
	$(\Delta\theta =)$ 21.5 – 19 OR $(\Delta\theta =)$ 2.5 (°C)	**B1**
	$(\Delta E =)$ 0.6(0) × 4200 × 2.5 **OR** $(\Delta E =)$ 0.6(0) × 4200 × {21.5 – 19}	**B1**
4(a)(ii)	(maximum possible efficiency =) 3.1% or 0.031	**A4**
	$E = Pt$ **OR** $(E =) Pt$ **OR** $(E =)$ 13 × 500 **OR** $(E =)$ 6500	C1
	(useful energy output =) 6500 – 6300 **OR** (useful energy output =) 200	C1
	efficiency = useful energy (output) / total energy (input) (× 100%) **OR** (efficiency =) useful energy (output) / total energy (input) (× 100%) **OR** (efficiency =) {6500 – 6300} / 6500 **OR** (efficiency =) 200 / 6500 (× 100%)	C1
	OR	
	$P = E/t$ **OR** $(P =)$ E / t **OR** $(P =)$ 6 300 / 500 OR $(P =)$ 12.6 (W)	(C1)
	(useful power output =) total power (output) – wasted power (output) **OR** (useful power output =) 13 – {6300 / 500} **OR** (useful power output =) 13–12.6	(C1)
	efficiency = useful power (output) / total power (input) (× 100%) **OR** (efficiency =) useful power (output) / total power (input) (× 100%) **OR** (efficiency =) 0.4 / 13 (× 100%)	(C1)
4(b)	any **one** from: • temperature change is an underestimate (due to thermal energy losses) • (thermal energy is) transferred from the water (to air / beaker / bench) • energy (other than light) transferred in lamp (filament / glass / internal structure) • (some) water evaporates	**B1**

Question	Answer	Marks
5(a)	(light / electromagnetic radiation) of a single frequency	**B1**
5(b)	angle of incidence / i = 0 **OR** incident ray along normal **OR** all of wavefront enters block at same time	**B1**
	angle of refraction / r = 0 **OR** no refraction **OR** whole wavefront slows down at same time	**B1**
5(c)	(c =) $\sin^{-}1\{1/1.5\}$ (= 42°) **OR** (c =) $\sin^{-1}\{1/n\}$ = 41.8°	**A2**
	n = 1 / sin c **OR** (c =) $\sin^{-1}\{1/n\}$ **OR** (c =) 41.8°	C1
5(d)(i)	<u>all</u> light is reflected	**B1**
	θ / angle of incidence > c / critical angle	**B1**
5(d)(ii)	<u>all</u> light is reflected **OR** reflected ray at 90° to incident ray **OR** reflected ray is parallel to original ray	**B1**

Question	Answer	Marks
6(a)	(wavelength =) 0.16 m	**A2**
	$v = f\lambda$ **OR** (λ =) v / f **OR** (λ =) $3 \times 10^8 / 1.9 \times 10^9$	C1
6(b)	(microwaves) only need short aerials / antennas	**B1**
	(microwaves) penetrate (some) walls	**B1**

Question	Answer	Marks
6(c)(i)	labelled diagram of digital (signal) with blocks of high (1) and low (0) **AND** labelled diagram of analogue with continuously variable signal	**B1**
	digital (signal) consists of <u>two</u> values owtte	**B1**
	analogue (signal) varies over a range (of values) owtte	**B1**
6(c)(ii)	any **two** from: • faster (data) transmission rate **OR** data can be compressed • data / signal transmitted over long(er) distances (as signal can be regenerated) • noise easily removed (from signal / data) **OR** signal can be regenerated	**B2**

Question	Answer	Marks
7(a)	any **two** from: • (potential divider) splits / shares / divides the e.m.f. / voltage / potential difference / p.d. (of a power source / in a circuit) • (e.m.f. is) split between (two) resistors / components (connected in series to power source) • (potential divider shares e.m.f.) in proportion to the resistances (of the resistors / components)	**B2**
7(b)(i)	(e.m.f. =) 15 V	**B1**
7(b)(ii)	(resistance =) 60 Ω	**A3**
	($R_{\|\|}$ =) R_2R_3 / (R_2 + R_3) **OR** ($R_{\|\|}$ =) 40 × 40 / (40 + 40) **OR** ($R_{\|\|}$ =) 1600 / 80 **OR** 1 / $R_{\|\|}$ = 1 / R_2 + 1 / R_3 **OR** 1 / $R_{\|\|}$ = 1 / 40 + 1 / 40 **OR** ($R_{\|\|}$ =) (1 / 40 + 1 / 40)$^{-1}$ **OR** ($R_{\|\|}$ =) 20 (Ω)	C1
	(resistance =) 40 + (candidate's value for combined resistance of R_2 and R_3)	C1

Question	Answer	Marks
7(c)	(reading =) 10 V	**A2**
	emf shared in same proportion as resistance **OR** e.g. $R_1 / R_{II} = V_1 / V_{II}$ **OR** (reading =) $15 \times 40 / 60$ **OR** (reading =) 0.25×40	C1

Question	Answer	Marks
8(a)	any **four** from: • alternating current in (primary coil) • (current in primary generates) changing magnetic field • iron core concentrates (magnetic) field **OR** iron core transfers (magnetic) field (to secondary coil) • secondary coil is in alternating / changing (magnetic) field **OR** secondary coil cuts (magnetic) field • e.m.f. induced (in secondary coil)	**B4**
8(b)(i)	(number of turns =) 3000	**A2**
	$N_p / N_s = V_p / V_s$ **OR** (N_p =) $N_s V_p / V_s$ **OR** (N_p =) $450 \times 220\,000 / 33\,000$	C1
8(b)(ii)	(current =) 350 A	**A3**
	$P = IV$ **OR** (I =) P / V **OR** (I =) $7.7 \times 10^7 / 220\,000$	C1
	(I =) 3.5×10^N	C1

Question	Answer	Marks
9(a)	(number of neutrons =) 7	**B1**
	any **one** from: • number of electrons = number of protons • white dots are protons / there are 5 protons • grey dots are neutrons • (number of neutrons) = 12 – 5	**B1**
9(b)(i)	(X2 has) one more proton more and one fewer neutron (than X1) **OR** (X2 has) 6 protons and 6 neutrons	**A2**
	(X2 has) one neutron fewer / one more proton (than X1) **OR** (X2 has) 6 protons / 6 neutrons	C1
9(b)(ii)	(X2) has fewer (excess) neutrons (in its nucleus) ORA	**B1**
9(c)(i)	time (taken)	**M1**
	for number of (radioactive) nuclei / atoms (in a sample of X1) to halve **OR** for rate of decay to halve	**A1**
9(c)(ii)	large number of particles produced in short time **OR** high / large decay rate **OR** high dose (of radiation) in short time	**B1**

Question	Answer	Marks
10(a)(i)	(speed) decreases (from X to Y) and then increases (from Y to X)	**B1**

Question	Answer	Marks
10(a)(ii)	any **three** from: • gravitational (potential) energy (GPE) transfers to kinetic energy (KE) or vice versa • KE transfers to GPE from X to Y **AND** GPE transfers to KE from Y to X • speed decreases as KE decreases / ORA • most GPE at Y **OR** least GPE at X • total (of GPE + KE) energy is constant	**B3**
10(b)(i)	–230 (°C)	**B1**
10(b)(ii)	(white surface) is a poor absorber / good reflector / poor emitter of IR / radiation **OR** black / other surface is a good absorber / poor reflector / good emitter of IR / radiation	**B1**
	any **one** from: • (the white surface) increases in temperature **less** when facing the Sun • (the white surface) decreases in temperature **less** when facing away (from Sun) • the black / other surfaces increases in temperature **more** when facing the Sun • the black / other surface decreases in temperature **more** when facing away (from Sun) • less variation in temperature on white surface (during one whole rotation)	**B1**