



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

PHYSICS

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Paper 4 Extended Theory

March 2018

MARK SCHEME

Maximum Mark: 80

Published

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Question	Answer	Marks
1(a)	Rate of change of velocity OR change of velocity / time OR change of velocity over time OR $(v - u)/t$	B1
1(b)(i)	Straight line from origin to (15, 28)	B1
	Horizontal line {from (15, 28)} to (32, 28)	B1
	$a = (v - u) / t$ OR $(t =) (v - u) / a$ OR $(0 - 28) / 2.0$	C1
	$= 14$ (s)	C1
1(b)(ii)	Straight line from (32, 28) to (46, 0)	A1
	1 Towards the centre of the circle / inwards	B1
	2 Velocity is (continually) changing its direction	B1

Question	Answer	Marks
2(a)	(Because g.p.e. is) the work done by the force OR the force $\times$ the distance that the object rises OR mgh and height is <u>greater</u>	B1
2(b)	mgh OR $80 \times 65 \times 10 \times 1600$ 8.3×10^7 J	C1 A1
2(c)	<u>Method 1</u> W = Pt OR E = Pt in any form Work input = $1500 \times 10^3 \times 30 \times 60$ OR 2.7×10^9 J Efficiency = work output / work input ($\times 100$) 0.031 OR 3.1 % <u>Method 2</u> P = E/t in any form Power output = $8.3 \times 10^7 / 30 \times 60$ Efficiency = power output / power input ($\times 100$) 0.031 OR 3.1%	C1 C1 C1 A1 (C1) (C1) (C1) (A1)

Question	Answer	Marks
3(a)	...(the) force $\times$ its <u>perpendicular</u> distance from pivot / a point	B1
3(b)(i)	centre of mass	B1
3(b)(ii)	(mass $\Rightarrow$) $160 / 10 = 16 \text{ kg}$	B1
3(b)(iii)	(Not moving up or down because) no resultant (vertical) force OR upward force = downward force	C1
	$80 \text{ N} + 80 \text{ N} = 160 \text{ N}$	A1
	(Not rotating because) no resultant moment (about any point) OR (sum of) clockwise moments = (sum of) anticlockwise moments	C1
	clockwise moment (about centre) = 80×1.2 anticlockwise moment (about centre) = 80×1.2	A1

Question	Answer	Marks
4(a)	Molecules of hot liquid collide with (surface of) spoon	B1
	transfer energy / heat to (molecules of) spoon	B1
	(amplitude of) vibration of spoon's molecules increases / is faster (increasing spoon's temperature)	B1
4(b)	Molecules of hot liquid (also) transfer energy to (free) electrons in the spoon	B1
	These (free) electrons move through the metal	B1
4(c)	($Q =$) $mc\Delta\theta$	C1
	$150 \times 4.2 \times (80 - 56)$	C1
	15000 J	A1

Question	Answer	Marks
5(a)(i)	Sketch showing straight lines with sudden changes of direction	B1
5(a)(ii)	Any 3 marks from 4 points:	
	Air molecules move in random / different directions	B1
	Smoke particles are hit	B1
	by air molecules	B1
5(b)	Change direction at each collision OR undergo Brownian motion	B1
	$F = (mv - mu) / t$ in any form OR Impulse = $mv - mu$	C1
	$= 20 \times 4.2 / 60$	C1
	1.4 N	A1

Question	Answer	Marks
6(a)	A: infra-red B: ultra-violet C: X-(rays) D: γ -(rays)	B2
6(b)(i)	$n = \sin i / \sin r$ OR $\sin r = \sin i / n$ OR $\sin r = \sin 35 / 1.50$	C1
	$r = 22^\circ$	A1
6(b)(ii)	Refraction at XY drawn with $r < i$	B1
	Refraction at XZ drawn with $r > i$	B1
6(b)(iii)	Blue ray drawn below red ray in prism and drawn with $r < i$	M1
	Ray to right of prism diverging downwards from red ray	A1

Question	Answer	Marks
7(a)	n = speed in air / speed in water OR speed in water = $3.0 \times 10^8 / 1.33$	C1
	$2.3 \times 10^8 \text{ m/s}$	A1
Answers to (b)(i), (b)(ii) and (b)(iii) all combined to maximum of 5 marks on same screen		
7(b)(i)	Wavefronts in plastic: meet wavefronts in air	B1
	make smaller angle with boundary than wavefronts in air and downwards to the left	B1
	parallel to each other	B1
7(b)(ii)	Arrow(s) perpendicular to wavefronts in plastic and downwards to right	B1
7(b)(iii)	r in plastic between refracted wavefront and boundary	B1
	OR At a point where refracted wavefront meets boundary, normal to boundary drawn and line perpendicular to wavefront drawn. r in plastic between the two lines drawn	(B1)

Question	Answer	Marks
8(a)	P = IV OR (I =) 50 / 12	C1
	4.2 A	
8(b)(i)	(E =) QV	C1
	(E =) $270 \times 10^3 \times 12$	C1
	$3.2 \times 10^6 \text{ J} / 3200 \text{ kJ}$	A1
8(b)(ii)	Volume of fuel used = $3.2 \times 10^6 / 3.6 \times 10^4$	C1
	89 cm ³ OR 90 cm ³ if 3.24 $\times 10^6$ used	A1

Question	Answer	Marks
9(a)(i)	Resistor: tick in 2nd box	B1
9(a)(ii)	Lamp: tick in 1st box	B1
9(b)	(R =) V / I OR (R =) 6.0 / 4.4	C1
	1.4 Ω	A1
9(c)	Current in lamp = 4.4 A Current in resistor = 4.0 A	C1
	Current from supply (= 4.0 + 4.4) = 8.4 A	A1
	OR (With 6 V p.d.) $R_L = 6 / 4.4 = 1.36 \Omega$ $R_R = 6 / 4 = 1.5 \Omega$ Combined resistance = $(1.36 \times 1.5) / 2.86 = 0.71 \Omega$	(C1)
	Current = $6 / 0.71 = 8.4$ A	(A1)
9(d)	p.d. across lamp = 4.9 V p.d. across resistor = 6.0 V	C1
	Total p.d. (= 4.9 + 6.0) = 10.9 V	A1
	OR (With 4 A current) $R_L = 5 / 4 = 1.25 \Omega$ $R_R = 6 / 4 = 1.5 \Omega$ Total R = 2.75 Ω	(C1)
	Total p.d. = 2.75 $\times$ 4 = 11.0 V	(A1)

Question	Answer	Marks
10(a)	Strength of magnetic field / magnet	B1
	Speed (of movement of wire)	B1
	Length of AB / wire (within field)	B1
10(b)(i)	$V_p / V_s = N_p / N_s$ OR ($N_s =$) $8000 \times 12 / 240$	C1
	400 (turns)	A1
10(b)(ii)	Circuit connected to A and B with resistor and diode with correct circuit symbols in series	B1

Question	Answer	Marks
11(a)(i)	In box / cupboard with lead walls	B1
11(a)(ii)	(Handle) with (long) tongs OR remote-controlled device OR wearing lead gloves OR wearing lead suit	B1
11(b)	Col 1: gamma / γ (rays) alpha / α (particles) beta / β (particles)	B1
	Col 3: – a few cm or up to 10 cm a few m or up to 10 m	B1
	Col 4: thick lead or 30 cm lead or very thick concrete or 3 m concrete – thin aluminium or 2 mm aluminium	B1
11(c)(i)	alpha / α (particles or rays)	B1
11(c)(ii)	beta / β (particles or rays)	B1