M17/4/PHYSI/SP2/ENG/TZ2/XX/M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Physics

Standard level

Paper 2

12 pages

Question			Answers	Notes	Total
1.	a		correct use of kinematic equation/equations ✓ 148.5 ***or*** 149 ***or*** 150 «m» ✓	*Substitution(s) must be correct.*	**2**
	b		$a = \frac{27}{11}$ ***or*** 2.45 «m s^{-2}» ✓ $F - 160 = 492 \times 2.45$ ✓ 1370 «N» ✓	*Could be seen in part (a).* *Award **[0]** for solution that uses a = 9.81 m s^{-2}*	**3**

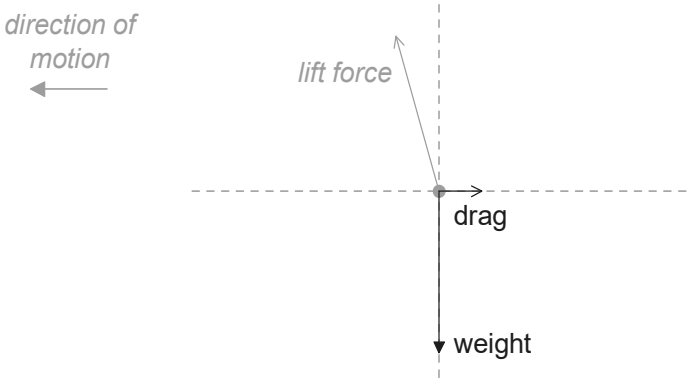
(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
	c		***ALTERNATIVE 1*** «work done to launch glider» $= 1370 \times 149$ « $= 204$ kJ» ✓ «work done by motor» $= \frac{204 \times 100}{23}$ ✓ «power input to motor» $= \frac{204 \times 100}{23} \times \frac{1}{11} = 80$ ***or*** 80.4 ***or*** 81 k«W» ✓ ***ALTERNATIVE 2*** use of average speed 13.5 m s^{-1} ✓ «useful power output» = force × average speed « $= 1370 \times 13.5$» ✓ power input $=$ «$1370 \times 13.5 \times \frac{100}{23} =$» 80 ***or*** 80.4 ***or*** 81 k«W» ✓ ***ALTERNATIVE 3*** work required from motor = KE + work done against friction « $= 0.5 \times 492 \times 27^2 + (160 \times 148.5)$» $= 204$ «kJ» ✓ «energy input» $= \frac{\text{work required from motor} \times 100}{23}$ ✓ power input $= \frac{883000}{11} = 80.3$ k«W» ✓	*Award **[2 max]** for an answer of 160 k«W».*	**3**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
	d		$\omega = \text{«}\frac{v}{r} = \text{»}\frac{27}{0.6} = 45$ ✓ rad s^{-1} ✓	*Do not accept Hz.* *Award **[1 max]** if unit is missing.*	**2**
	e		 drag correctly labelled and in correct direction ✓ weight correctly labelled and in correct direction ***AND*** no other incorrect force shown ✓	*Award **[1 max]** if forces do not touch the dot, but are otherwise OK.*	**2**

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
	f		name Newton's first law ✓ vertical/all forces are in equilibrium/balanced/add to zero ***OR*** vertical component of lift mentioned ✓ as equal to weight ✓		**2 max**
	g		any speed and any direction quoted together as the answer✓ quotes their answer(s) to 3 significant figures ✓ speed $= 12.7\ \text{m s}^{-1}$ ***or*** direction $= 9.46^\circ$ ***or*** 0.165 rad **«**below the horizontal**»** ***or*** gradient of $-\frac{1}{6}$ ✓		**3**

Question			Answers	Notes	Total
2.	a		PE of water is converted to KE of moving water/turbine to electrical energy «in generator/turbine/dynamo» ✓ idea of pumped storage, *ie*: pump water back during night/when energy cheap to buy/when energy not in demand/when there is a surplus of energy ✓		2
	b		total energy $= «2.7 \times 10^3 \times 1.5 \times 10^{10} =» 4.05 \times 10^{13}$ «J» ✓ time $= «\frac{4.0 \times 10^{13}}{4 \times 2.5 \times 10^8} =» 11.1$ h ***or*** 4.0×10^4 s ✓	*For MP2 the unit **must** be present.*	2
	c		friction/resistive losses in walls of pipe/air resistance/turbulence/turbine and generator bearings ✓ thermal energy losses, in electrical resistance of components ✓ water requires kinetic energy to leave system so not all can be transferred ✓	*Must see "seat of friction" to award the mark. Do not allow "friction" bald.*	1 max
	d		area required $= \frac{1 \times 10^9}{0.22 \times 180} «= 2.5 \times 10^7 \text{ m}^2»$ ✓ length of one side $= \sqrt{\text{area}} = 5.0$ k«m» ✓		2

Question			Answers	Notes	Total
3.	a		«light» superposes/interferes ✓ pattern consists of «intensity» maxima and minima ***OR*** consisting of constructive and destructive «interference» ✓ voltage peaks correspond to interference maxima ✓		3
	b	i	«$s = \frac{\lambda D}{d} = \frac{6.3\times10^{-7}\times5.0}{1.5\times10^{-3}} =$» 2.1×10^{-3}«m» ✓	*If no unit assume m.* *Correct answer only.*	1
	b	ii	correct read-off from graph of 25 m s ✓ $v =$ «$\frac{x}{t} = \frac{2.1\times10^{-3}}{25\times10^{-3}} =$» 8.4×10^{-2} «m s^{-1}» ✓	*Allow ECF from (b)(i)*	2

(continued…)

(Question 3 continued)

Question			Answers	Notes	Total
	c		***ALTERNATIVE 1*** «reflection at barrier» leads to two waves travelling in opposite directions ✓ mention of formation of standing wave ✓ maximum corresponds to antinode/maximum displacement «of air molecules» ***OR*** complete cancellation at node position ✓		**2 max**

Question			Answers	Notes	Total
4.	**a**		222 ***AND*** 4 ✓	*Both needed.*	**1**
	b		alpha particles highly ionizing ***OR*** alpha particles have a low penetration power ***OR*** thin glass increases probability of alpha crossing glass ***OR*** decreases probability of alpha striking atom/nucleus/molecule ✓		**1**
	c		conversion of temperature to 291 K ✓ $p = 4.5 \times 10^{-9} \times 8.31 \times \left(\frac{291}{1.3 \times 10^{-5}} \right)$ ***OR*** $p = 2.7 \times 10^{15} \times 1.38 \times 10^{-23} \times \left(\frac{291}{1.3 \times 10^{-5}} \right)$ ✓ 0.83 ***or*** 0.84 «Pa» ✓	*Allow ECF for 2.7×10^{15} from (b)(ii).*	**3**

(continued…)

(Question 4 continued)

Question			Answers	Notes	Total
	d		electron/atom drops from high energy state/level to low state ✓ energy levels are discrete ✓ wavelength/frequency of photon is related to energy change ***or*** quotes $E = hf$ ***or*** $E = \frac{hc}{\lambda}$ and is therefore also discrete ✓		**3**
	e		peer review guarantees the validity of the work ***OR*** means that readers have confidence in the validity of work ✓	*OWTTE*	**1**

Question			Answers	Notes	Total
5.	a		when an electric field is applied to any material «using a cell etc» it acts to accelerate any free electrons ✓ electrons are the charge carriers «in copper» ✓ metals/copper have many free electrons whereas insulators have few/no free electrons/charge carriers ✓	*Accept "free/valence/delocalised electrons".*	**3**
	b	i	area $= \frac{1.7 \times 10^{-3} \times 35 \times 10^{3}}{64}$ «$= 9.3 \times 10^{-6}\,\text{m}^2$» ✓		**2**
	b	ii	«resistance of cable $= 2\,\Omega$» power dissipated in cable $= 730^2 \times 2$ «$= 1.07\,\text{MW}$» ✓ power loss per meter $= \frac{1.07 \times 10^{6}}{35 \times 10^{3}}$ ***or*** $30.6\,\text{«W m}^{-1}\text{»}$ ✓	*Allow **[2]** for a solution where the resistance per unit metre is calculated using resistivity and answer to (b)(i) (resistance per unit length of cable $= 5.7 \times 10^{-5}\,\text{m}$)*	**2**
	b	iii	$30 = m \times 390 \times 3.5 \times 10^{-2}$ ✓ 2.2 k«g» ✓	*Correct answer only.*	**2**