01. 0625_m23_ms_42 Q: 2

Question	Answer	Marks
(a)	ship is not solid steel / there are air spaces in ship	**B1**
	(average) density of ship is less than the density of the water	**B1**
(b)	the centre of gravity is lower and (so) the ship is more stable	**A2**
	the centre of gravity is lower **OR** ship more stable	(C1)
(c)	1.4×10^7 J **OR** 14 MJ **OR** 14 000 kJ	**A2**
	$\Delta E_p = mg(\Delta)h$ **OR** ($\Delta E_p =$) $mg(\Delta)h$ **OR** $30\,000 \times 9.8 \times 48$	(C1)

02. 0625_m23_ms_42 Q: 3

Question	Answer	Marks
(a)	energy cannot be created or destroyed	**B1**
	energy can be transferred / transformed (between energy stores)	**B1**
(b)(i)	energy transferred in one hour at a rate of transfer of 1 kW	**B1**
(b)(ii)	7200 (kWh)	**A2**
	$(\Delta)E$ = Pt **OR** (ΔE) = Pt **OR** 1800×4.0 **OR** 1.8×4.0 **OR** 7.2×10^n	(C1)
(c)	any **two** from: • geothermal • nuclear • tidal	**B2**

03. 0625_s23_ms_42 Q: 1

Question	Answer	Marks
(a)(i)	no resultant / net force	**B1**
	no resultant/net moment	**B1**
(a)(ii)	4.7×10^7 J or 47 MJ	**A2**
	$(\Delta)E_p = mg(\Delta)h$ **OR** $(\Delta E_p =)\ mg(\Delta)h$ **OR** $(\Delta E_p =)\ 3200 \times 9.8 \times 1500$	C1
(b)(i)	point, labelled 1, on either of the horizontal sections of the graph (to the left of A or to the left of B)	**B1**
	point, labelled 2, on the graph between A and the start of the horizontal section of the graph to the left of B	**B1**
	point, labelled 3, on the graph between the start of the curved section to the right of the origin and the start of the horizontal section of the graph to the left of A	**B1**
(b)(ii)	(initially there is acceleration due to) weight **OR** gravitational force **OR** unbalanced force / resultant force / downward force	**B1**
	(then) air resistance increases as speed or velocity increases	**B1**
	(as air resistance increases) resultant force downwards decreases **OR** acceleration decreases	**B1**
	constant speed when air resistance = weight / gravitational force	**B1**

04. 0625_s23_ms_42 Q: 2

Question	Answer	Marks
(a)	26 J	**A3**
	$E_K = \frac{1}{2}mv^2$ **OR** $(E_K =)\ \frac{1}{2}mv^2$ **OR** $(E_K =)\ \frac{1}{2} \times 0.16 \times (18)^2$	C1
	$(E_K =)\ \frac{1}{2} \times 0.16 \times (18)^2$ **OR** $(E_K =)\ \frac{1}{2} \times 0.16 \times 324$ **OR** $(E_K =)\ 2.6 \times 10^N$	C1

Question	Answer	Marks
(b)	24 N	**A2**
	$Ft = \Delta mv$ **OR** $F = ma$ **OR** $(F =)\ (0.16 \times 18) / 0.12$	C1
(c)	longer time (of impact / contact) **AND** smaller force (on them) **OR** longer time (of impact / contact) **AND** does not hurt as much	**B1**

05. 0625_w23_ms_41 Q: 1

Question	Answer	Marks
(a)	20 J	**A2**
	($\Delta.E_p$ =) $mg(\Delta)h$ **OR** $0.2(0)\times9.8\times10$	C1
(b)(i)	14 J	**A2**
	(E_k =) $\frac{1}{2}mv^2$ **OR** $\frac{1}{2}\times0.2(0)\times12^2$	C1
(b)(ii)	$p = mv$ **OR** (Δp =) $mv–mu$	**B1**
	(Δp =) $0.2(0)\times\{14+12\}$ **OR** $0.2(0)\times\{14--12\}$ **OR** $p_{\text{before}} = 0.2(0)\times14$ **AND** $p_{\text{after}} = 0.2(0)\times(-)12$	**B1**
	(Δp =) $2.8-\{-2.4\}$ (= 5.2 kg m / s) **OR** (Δp =) $0.2(0)\times\{14--12\}$	**B1**
(b)(iii)	21 N	**A2**
	(F =) Δp / (Δ)t **OR** $F = (\Delta)mv / (\Delta)t$ **OR** 5.2 / 0.25	C1

06. 0625_w23_ms_41 Q: 5

Question	Answer	Marks
(a)	*Any three from:* • description of how the (energy from) water is released • mention of transfers between energy stores • (moving) water turns turbine • turbine turns / drives generator • name of method to match description	**B3**
(b)	advantage of generating electricity from energy stored in water	**B1**
	disadvantage of generating electricity from energy stored in water	**B1**
(c)	any **two** from: • geothermal (energy / power) • tidal (energy / power) • nuclear (energy / power)	**B2**

07. 0625_w23_ms_42 Q: 1

Question	Answer	Marks
(a)(i)	4.1 m / s^2	**A2**
	(*a* =) (Δ)*v* / (Δ)*t* OR 13(.0) / 3.2	C1
(a)(ii)	(acceleration is) change / increase in velocity per unit time OR rate of change of velocity	**B1**
(b)(i)	straight line joining (0,0) and (3.2,13.0)	**B1**
	horizontal line from 3.2 s to 12.0 s	**B1**
(b)(ii)	21 m	**A2**
	area under speed-time graph (between 0 s and 3.2 s) OR average velocity × time	C1
(c)	(*W* =) *F* × *d*	**B1**
	F = *ma* **OR** *F*(Δ)*t* = *m*Δ*v*	**B1**
	F= (1350 × 13) ÷ 2 **OR** 8775 (N) **OR** (*F*=) 1350 × 6.5	**B1**
	W = 8775 × 13.0 (= 1.1 × 10^5 J) OR 114 075 (J)	**B1**
(d)	any sensible suggestion that increases the stopping distance	**B1**
	explanation (to match suggestion)	**B1**

08. 0625_w23_ms_43 Q: 3

Question	Answer	Marks
(a)	1.3 kg m / s	**A2**
	p = *mv* **OR** (*p* =) *mv* **OR** 0.19 × 6.9 **OR** 190 × 6.9 **OR** 1.3 × 10^n	C1
(b)	(speed of object =) 0.89 m / s **OR** 0.88 m / s	**A3**
	momentum before (collision) = momentum after (collision) **OR** 1.3 (kg m / s) = –(0.19 × 1.5) (kg m / s) + 1.8 *v* (kg m / s) **OR** (momentum of object =) 1.3 (kg m / s) + (0.19 × 1.5) (kg m / s) **OR** (momentum of object =) 1.3 (kg m / s) + 0.29 (kg m / s) **OR** (momentum of object =) 1.6 (kg m / s)	C1
	(speed of object =) {1.3 + (0.19 × 1.5)} / 1.8 (m / s) **OR** (speed of object =) 1.6 / 1.8	C1
(c)	(loss of *KE* =) 3.8 J **OR** 3.6 J	**A3**
	KE = ½ mv^2 **OR** (KE =) ½ mv^2 **OR** ½ × 1.8 × 0.89^2	C1
	((final) *KE* of object) = 0.70 (J) **OR** 0.71 (J) **OR** (Δ*KE* =) 4.5 – (0.2 + calculated *KE* of object)	C1

09. 0625_m22_ms_42 Q: 2

Question	Answer	Marks
(a)(i)	extension (of the spring) is (directly) proportional to the force / load (applied to the spring, up to the limit of proportionality)	**B1**
(a)(ii)	W=mg in any form OR force is (directly) proportional to mass	**B1**
(a)(iii)	80 N	**B1**
(b)	straight line through / from origin with positive gradient up to 175 N	**B1**
	smooth curve after 175 N with increasing positive gradient	**B1**
(c)	(80 N × 3.5 m =) 280 J	**A2**
	ΔE = Fxd in any form OR GPE= mgh in any form	**(C1)**

10. 0625_s22_ms_42 Q: 1

Question	Answer	Marks
(a)(i)	(E =) 2 200 000 (J) OR 2.2 × 10^6 (J)	**A3**
	(E =) Pt in any form	C1
	(E =) 600 × 3600	C1
(a)(ii)	chemical	**B1**
(b)	(t =) 8600 s OR 140 min OR 2.4 h OR 2 h 24 min OR (t =) 8800 s OR 147 min OR 2 h 27 min	**A2**
	(t =) 2.2 × 10^6 / 250 OR (600 × 60) / 250 OR 1 × 600 / 250	C1
(c)	any **two** from: • less noise OR no noise • less OR no air / gaseous pollution (from the bicycle) OR does not produce acid rain • (the bicycle) uses no / less fossil fuel • does not contribute to greenhouse effect OR does not release CO_2	**B2**

11. 0625_s22_ms_42 Q: 3

Question	Answer	Marks
(a)	scale at least 2 cm : 1 m / s stated	**B1**
	2.5 m / s AND 4.0 m / s vectors correctly drawn by eye **AND** correct resultant	**M1**
	magnitude of resultant velocity = 2.3 – 2.8 m / s inclusive	**A1**
	direction 35° – 40° inclusive (downstream)	**A1**
(b)	(E = ½ × 65 × 2.5^2 =) 200 J	**A2**
	(E =) ½ mv^2 in any form	C1

12. 0625_s22_ms_43 Q: 2

Question	Answer	Marks
(a)	gravitational potential (energy)	**B1**
(b)(i)	2.0×10^6 J / s	**A3**
	(P =) E/t in any form OR (480 × 10 × 410)/1	C1
	(ΔGPE =) mgh in any form OR 480 × 10 × 410	C1

Question	Answer	Marks
(b)(ii)	81 (%) OR 82 (%)	**A3**
	$P = V I$ in any form OR 6000 × 270 OR 1 620 000	C1
	(efficiency =) (useful) power out / (total) power in (× 100%) in any form	C1
(c)(i)	damage to habitats (for fish) / construction is expensive / droughts / flood risk if dam bursts	**B1**
(c)(ii)	biofuel / wind / geothermal / tidal / solar / wave	**B1**

13. 0625_w22_ms_41 Q: 1

Question	Answer	Marks
(a)	2.3 J	**A2**
	Δg.p.e. = $mg\Delta h$ in any form **or** 0.50 × 10 × 0.45	C1
(b)(i)	1.2 N s	**A3**
	impulse = change in momentum **or** 2.0 × 0.60	C1
	$I = m\Delta v$ in any form **or** 2.0 × 0.60	C1
(b)(ii)		**B3**
	kinetic energy (of block A) decreases	B1
	thermal / internal energy produced / increases (due to friction)	B1
	friction mentioned **or** block slows down / decelerates	B1

14. 0625_w22_ms_42 Q: 3

Question	Answer	Marks
(a)(i)	*any one from*: • fossil fuel / named fossil fuel • biofuel / wood / crops • hydro • wave • wind • solar cell / panel.	**B1**
(a)(ii)	geothermal **OR** nuclear	**B1**
(b)(i)	yes **OR** it is renewable	**B1**
	tides are continuous / regular / happen every day / always there / owtte **OR** Moon / Sun always there **OR** nothing is consumed / used up **OR** tides are an unlimited resource	**B1**
(b)(ii)	(power =) 4800 W	**A4**
	KE = $\frac{1}{2}mv^2$	C1
	(P =) E / t **OR** (P =) KE / s **OR** (KE / s =) $\frac{1}{2} \times 6(.0) \times 10^3 \times 2(.0)^2$	C1
	electrical (output) power = 40% of KE / s **OR** $0.4 \times 12\,000$	C1

15. 0625_w22_ms_43 Q: 2

Question	Answer	Marks
(a)(i)	4.5 kg m / s	**A3**
	$p = mv$ **OR** (change in momentum =) $mv - mu$	C1
	(change in momentum =) $(0.058 \times 52) - (-0.058 \times 26)$ **OR** $(0.058 \times 52) + (0.058 \times 26)$ **OR** $(0.058 \times -26) - (0.058 \times 52)$	C1
(a)(ii)	(impulse =) force $\times$ time **OR** (impulse =) Ft	**B1**
(a)(iii)	0.013 s	**A2**
	(t =) change in momentum / F **OR** (t =) $m(v-u) / F$ **OR** (t =) $\Delta p / F$ **OR** 4.5 / 350	C1
(b)	59 J	**A3**
	KE = $\frac{1}{2}mv^2$ **OR** (KE =) $\frac{1}{2}mv^2$	C1
	(change in KE) = $\frac{1}{2}\ 0.058 \times 52^2 - \frac{1}{2}\ 0.058 \times 26^2$ **OR** $\frac{1}{2}\ 0.058 \times 26^2 - \frac{1}{2}\ 0.058 \times 52^2$	C1

16. 0625_w22_ms_43 Q: 3

Question	Answer	Marks
(a)	5 correct: 3 marks, 3 or 4 correct: 2 marks, 2 correct: 1 mark gravitational potential water (tidal) bay kinetic turbines	B3
(b)	any **one** advantage from: • renewable • reliable or predictable • running cost low • does not produce (harmful) pollution. any **one** disadvantage from: • (high) cost of construction • possible effects on (marine) life • not available all day • power produced doesn't always match with peak demand • limited number of sites • maintenance difficult / increased corrosion (because underwater).	B2
(c)	Moon	B1

17. 0625_s21_ms_41 Q: 2

	Answer	Mark
(a)(i)	0.078 N s **or** 0.078 kg m / s	A2
	(I =) $m_t(\Delta)v_t$ in any form **or** 1.2×0.065	C1
(a)(ii)	150 m / s	A2
	$v_b = (m_t + v_t) / m_b$ in any form **or** initial momentum = final momentum **or** 1.2(0052) × 0.065 / 0.00052 **or** 0.078(0338) / 0.00052	C1
(b)	work done against / due to / because of friction **or** kinetic energy (of trolley) used to do work	B1
	kinetic energy decreases (to zero)	B1
	thermal energy produced	B1

18. 0625_s21_ms_42 Q: 3

	Answer	Mark
(a)	(PE loss =) mgh AND (KE gain =) ½ mv^2	B1
	PE (loss) = KE (gain)	B1
	alternative route 1 for 1st two m.p.s	
	$v^2 = u^2 + 2as$	(B1)
	u = 0	(B1)
	alternative route 2 for 1st two m.p.s	
	$s = ut + 0.5at^2$ OR $h = 0.5gt^2$	(B1)
	u = 0 AND $t = \sqrt{3}$ OR 1.73	(B1)
	v^2 (= 2gh) = $2 \times 10 \times 15$ OR $v^2 = 300$ OR $v = 10\sqrt{3}$ OR $v = 10 \times 1.73$	B1
	{v = 17 m / s AND $v^2 = 300$ or $v = 10\sqrt{3}$} OR v = 17.3(2) m / s	B1

	Answer	Mark
(b)	(F =) change of p / (change of) time OR rate of change of momentum	C1
	(F =) 30 × 17.32	C1
	(F =) 520 N	A1

19. 0625_s21_ms_43 Q: 1

	Answer	Mark
(a)	(extension =) 15 cm	A2
	$F = kx$ **OR** $x = F/k$ **OR** 3.0/0.2	C1
(b)	extension is proportional to load	B1
	up to the limit of proportionality, extension proportional to load	B1
(c)	graph initially straight line with positive gradient that passes through the origin	B1
	point labelled, increasing gradient to the right	B1
(d)	• from elastic / strain energy • to gravitational potential energy EITHER: • to kinetic energy, when moving from A to equilibrium OR from kinetic energy, when moving from equilibrium to B	B3

20. 0625_s21_ms_43 Q: 3

	Answer	Mark
(a)	thinking time is constant	B1
(b)	kinetic energy	B1
	kinetic energy = ½ mv^2	B1
	work done (to lose KE) = Fd (so stopping distance is proportional to v^2)	B1
	OR (alternative route)	
	time to decelerate is proportional to v	(B1)
	d = average $v \times t$ = ½ $v \times t$	(B1)
	d is proportional to v^2	(B1)
(c)(i)	0.68 s	A2
	$t = d/v$ OR 15/22 in any form	C1
(c)(ii)	15 000 N	A2
	Ft = change in momentum OR F × 2.1 = 1400 × 22 in any form OR $F = ma$ OR (F =)(1400 × 22)/2.1)	C1

21. 0625_w21_ms_41 Q: 4

Question	Answer	Marks
(a)(i)	straight line begins at (15 s, 120 m) **and** continues to end of given line	**B1**
(a)(ii)	curve with increasing gradient from origin to beginning of candidate's **(a)(i)**	**B1**
(b)	(E_k =) ½mv^2 in any form	**C1**
	½ × 1.8 × 10^5 × 20^2	**C1**
	3.6 × 10^7 J	**A1**
(c)(i)	(work done =) force × distance (moved in the direction of the force)	**C1**
	(work done =) force × distance moved in the direction of the force	**A1**
(c)(ii)	240 m **c.a.o.**	**B1**
(c)(iii)	3.6 × 10^7 / 240 **or** kinetic energy / distance **or** (a =) 20 / 24 **or** $\Delta v / t$ in any form **or** 0.83 **or** (F =) ma in any form	**C1**
	1.5 × 10^5 N	**A1**

22. 0625_w21_ms_42 Q: 4

Question	Answer	Marks
(a)	(statement) renewable	**B1**
	(explanation) (wind) is) replaced / replenished OR does not run out OR is not used up OR is an infinite energy resource	**B1**
(b)	any **two** from: geothermal nuclear tidal	**B2**
(c)	chemical	**B1**
	gravitational potential	**B1**

23. 0625_w21_ms_43 Q: 2

Question	Answer	Marks
(a)	(rate of transfer of gravitational potential energy =) 0.17 W	**A4**
	(gravitational PE lost =) mgh in any form OR 12 × 10 × 1.7	C1
	(gravitational PE lost =) 204 (J)	C1
	(gravitational PE lost / s =) 204 / 1200	C1
(b)	59% OR 0.59	**A2**
	efficiency = useful power output / power input (× 100%) in any form OR 0.10 / 0.17 × 100%	C1
(c)	any sensible advantage, e.g. no use of (fossil) fuel, no cost to run, can be used in remote areas, no CO_2 / air pollution, no greenhouse gases, does not contribute to global warming	**B1**

24. 0625_m20_ms_42 Q: 3

(a)(i)	KE = ½ mv^2 in any form OR $v^2 = 2 \times KE / m$ OR $240 = ½ \times 7.5\ v^2$	C1
	$v^2 = 2 \times 240 / 7.5$ OR (v=) $\sqrt{\{2 \times 240 / 7.5\}}$ OR (v=) $\sqrt{\{2KE / m\}}$	C1
	= 8.0 m / s	A1
(a)(ii)	240 W	B1
(b)(i)	P = VI in any form OR 11×2	C1
	22 W	A1
(b)(ii)	(efficiency =) P_o / P_i OR (efficiency =) P_o / P_i OR (efficiency =) $(11 \times 2 / 240) \times 100$	C1
	{efficiency = $(11 \times 2 / 240) \times 100$ =} 9.2 (%)	A1
(c)	$\rho = m / V$ in any form OR (V =) m / ρ OR (V =)7.5 / 1.3	C1
	(V = 7.5 / 1.3 =) 5.8 m^3	A1

25. 0625_s20_ms_41 Q: 1

(a)(i)	(a =) $(v - u) / t$ OR $(62 - 6.0) / 35$ OR 56 / 35	C1
	1.6 m / s^2	A1
(a)(ii)	(F =) ma OR $\Delta p / \Delta t$ OR $2.5 \times 10^5 \times 1.6$ OR $(62 \times 2.5 \times 10^5 - 6.0 \times 2.5 \times 10^5) / 35$	C1
	4.0×10^5 N	A1
(a)(iii)	(p =) mv OR $2.5 \times 10^5 \times 6.0$	C1
	1.5×10^6 kg m / s	A1
(b)	curve of decreasing gradient from (0,0) to a point along dashed line	B1
	straight line of positive gradient after t = 35 s	B1
	gradient not zero at t = 35 s OR no change of gradient (at t = 35 s)	B1
(c)	thermal energy AND in something specific (e.g. brakes / air / tyres) OR kinetic energy of air	B1

26. 0625_s20_ms_41 Q: 2

(a)	0 (N) AND 8.0 N	B1
(b)	(k =) F / x OR 8.0 / 0.15	C1
	53 N / m OR 0.53 N / cm	A1
(c)(i)	elastic potential (energy)	B1
(c)(ii)	15 cm	B1
(c)(iii)	7.5 cm OR 2(c)(ii) / 2	B1

27. 0625_w20_ms_41 Q: 2

Question	Answer	Marks
(a)	it / velocity / speed changes / increases (with time)	C1
	it / velocity / speed <u>increases</u> at constant rate / steadily	A1
(b)	any **three** from: • (initial) acceleration caused by weight / force of gravity • acceleration decreases • drag / resistance force increases (with speed) • (finally / at terminal velocity) no acceleration / constant speed • (finally / at terminal velocity) no resultant force	B3
(c)(i)	(GPE =) $mg\,(\Delta)\,h$ (in any form) **or** $0.0021 \times 10 \times 0.80$ **or** $2.1 \times 10 \times 0.80$ **or** 17 (J)	C1
	0.017 J	A1
(c)(ii)	(KE =) $\frac{1}{2}\,mv^2$ (in any form)	C1
	$\frac{1}{2} \times 0.0021 \times 1.2^2$ **or** $\frac{1}{2} \times 2.1 \times 1.2^2$ **or** 1.5 (J)	C1
	1.5×10^{-3} J	A1
(c)(iii)	(work done against) friction / drag / resistance **or** thermal energy generated **or** (displaced) liquid gains gravitational potential energy	B1

28. 0625_w20_ms_42 Q: 3

Question	Answer	Marks
	(output) $P = VI$ OR $E = VIt$ OR $E = Pt$ in any form words, symbols or numbers OR (P =) VI OR (P =) 240×9 OR (P =) 2160 (W) OR (E =) $240 \times 9 \times 60 = 129\,600$ (J)	C1
	(rate of energy input = 720 000 / 60 =) 12 000 (J / s) OR energy input = 720 000 (J)	C1
	(efficiency =) (100 ×) output power / input power OR (100 ×) output energy / input energy words, symbols or numbers	C1
	(efficiency =) $100 \times \{2160 / 12\,000\}$	C1
	(efficiency =) 18(%)	A1

29. 0625_w20_ms_43 Q: 2

Question	Answer	Marks
(a)	PE lost = KE gained, in any form	C1
	$v^2 = 2gh$ or $0.16 \times 10 \times 115 = 0.5 \times 0.16 \times v^2$	C1
	(speed =) 48 m / s	A1
(b)	momentum = mv	C1
	(momentum=) 7.7 kg m / s or 7.7 N s	A1

30. 0625_m19_ms_42 Q: 2

(a)	Advantage: No fossil fuel used OR No fuel costs OR No pollution of air / water OR No polluting gases OR is a renewable energy source OR doesn't contribute to global warming / greenhouse effect	B1
	Disadvantage: Wind not always blowing OR causes noise pollution OR causes visual pollution OR is danger to wildlife OR is expensive to build	B1
(b)(i)	**1** d = m/V in any form, symbols or words OR 24 000 × 1.3	C1
	31 000 kg	A1
	2 KE = ½ mv^2 OR ½ × 31 200 × 16^2	C1
	4.0 × 10^6 J	A1

(b)(ii)	Speed of air not reduced to zero (in passing through turbine) OR some air passes through blade area without change of speed OR without hitting blades OR not all k.e. of air transfers to blades OR air retains some of its k.e. OR friction in bearings of blades	B1

31. 0625_s19_ms_42 Q: 3

(a)	light	B1
(b)(i)	no air pollution/CO_2/acid rain/greenhouse gases/global warming/harmful gases OR no damage from mining/drilling	B1
	visual pollution/use of land/pollution during manufacture	B1
(b)(ii)	yes/renewable AND nothing used up o.w.t.t.e.	B1
(c)	(P_i =1.2 × 2.8 × 260 =) 870 (W)	C1
	(P_o = 2.5 × 86 =) 220 (W)	C1
	(efficiency =){P_o/P_i} × 100 in any form OR {P_o/P_i} × 100	C1
	(efficiency = {220/870} × 100 =) 25 (%)	A1

32. 0625_s19_ms_43 Q: 2

(a)	KE = 1/2 mv^2 in any form OR (KE) = 1/2 × 1.2 x 10^6 × 0.04^2	C1
	(KE =) 960 J	A1

(b)	EITHER	
	(change in momentum) = mv OR (change in momentum) = $1.2 \times 10^6 \times 0.04$	**C1**
	(=) 4.8×10^4 (kg m/s)	**C1**
	change in momentum = Ft in any form	**C1**
	(Force = $4.8 \times 10^4 / 0.3$ =) 1.6×10^5 N	**A1**
	OR	
	a = (v-u)/t = 0.04/0.3	**(C1)**
	= 0.13 (m/s^2)	**(C1)**
	F = ma	**(C1)**
	(Force = $1.2 \times 10^6 \times 0.13$ =) 1.6×10^5 N	**(A1)**
(c)	Work done or KE transferred = Fd in any form	**C1**
	(distance = $960 / 1.6 \times 10^5$ =) 6.0×10^{-3} m OR 0.006 m OR 0.60 cm	**A1**
(d)	smaller force (on dock/ship) because increases time of collision OR increased distance of collision (on the dock/ship)	**B1**

33. 0625_w19_ms_41 Q: 2

(a)	any **two** from: shape size / volume / length / density / any linear dimension direction (of motion) / speed / velocity / momentum / kinetic energy / acceleration	**B2**
(b)(i)	extension **and** tension / force / load mentioned extension is directly proportional to tension / force / load	**C1** **A1**
(b)(ii)1.	260 N	**B1**
(b)(ii)2.	$k = F/x$ in any form words, symbols or numbers **or** (k =) F/x **or** 260 / (0.94 – 0.63) **or** 260 / 0.31 840 N / m	**C1** **A1**
(b)(iii)	from chemical (potential energy) to elastic (potential) / strain (at end)	**B1** **B1**

34. 0625_w19_ms_43 Q: 3

(a)(i)	from gravitational potential	**B1**
	to kinetic	**B1**
(a)(ii)	KE gained = PE lost or $1/2mv^2 = mgh$	**C1**
	$h = v^2/2g$	**C1**
	22 m	**A1**
(a)(iii)	No energy lost to surroundings (as thermal energy) OR No air resistance	**B1**
(b)	Any **two** from geothermal, nuclear and tidal	**B2**

35. 0625_m18_ms_42 Q: 2

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

36. 0625_s18_ms_41 Q: 2

(a)	Chemical (potential energy)	1
(b)(i)	(E =) m × g × h **OR** 32 × 10 × 2.5	1
	800 J	1
(b)(ii)	Output power = E ÷ t **OR** 800 ÷ 5.4 **OR** 148.148 (W)	1
	Eff. = output (power) ÷ input (power) **OR** $P_{out} \div P_{in}$ **OR** $E_{out} \div E_{in}$ **OR** output power ÷ 0.65 **OR** 148.148 ÷ 0.65 **OR** 800 ÷ 0.65	1
	= 230 W	1
(c)	Advantage: not dependent on weather/wind blowing **OR** always available	1
	Disadvantage: polluting **OR** CO_2/SO_2/greenhouse gases emitted **OR** leads to global warming **OR** oil must be transported **OR** not renewable **OR** oil will run out/be used up	1

37. 0625_s18_ms_42 Q: 3

(a)	(*KE* =) ½ × *m* × v^2	1
	(*KE* =) ½ × 9500 × 75^2	1
	(*KE* =) 2.7 × 10^7 J	1
(b)	*KE* = *F* × *l* **OR** (*F* =)*KE* ÷ *l* **OR** (*F* =) 2.671875 × 10^7 × 150 **OR** $v^2 - u^2 = 2ax$ **OR** (*a* =) $v^2 - u^2 \div (2 \times x)$ **OR** (*a* =) $75^2 \div (2 \times 150) = 18.75$	1
	(*F* =) 1.8 × 10^5 N **OR** ((*F* =) *m* × *a* = 9500 × 18.75) = 1.8 × 10^5 N	1

38. 0625_s18_ms_43 Q: 2

(a)(i)	*(KE =)* ½ × *m* × v^2	C1
	½ × 0.020 × 350^2	C1
	1200 J	A1
(a)(ii)	(Δ*h* =) *KE* ÷ *mg* **OR** 1200 ÷ (0.020 × 10) **OR** 1225 ÷ (0.020 × 10)	C1
	6000/6100 m	A1
(b)(i)	(force of) air resistance acts downwards	M1
	adds to gravitational force/resultant force increases/deceleration increases/deceleration > *g*	A1
(b)(ii)	(kinetic energy) to gravitational potential energy	B1
	(kinetic energy) to thermal/internal energy	B1

39. 0625_w18_ms_41 Q: 3

(a)	Energy cannot be created or destroyed OR energy can only be transferred from one form to another OR total energy remains constant	B1
(b)(i)	Chemical (energy) to kinetic (energy) AND / OR potential (energy)	B1
	Any **one** of: Kinetic (energy) to potential (energy) OR gravitational (energy) Potential (energy) OR gravitational (energy) to kinetic (energy) Kinetic (energy) to thermal (energy) OR heat (energy)	B1
(b)(ii)1	(momentum =) *mv* OR 4.0 × 12	C1
	48 kg m / s or N s	A1
(b)(ii)2	(average force =) momentum change / time OR *m(v – u) / t* OR *(mv – mu) / t* OR *F = ma* AND *a = (v – u) / t* OR 48 / 0.60	C1
	80 N	A1

40. 0625_w18_ms_42 Q: 3

(a)	*mv – mu* or *mu – mv* in any form	B1
(b)(i)	(impulse =) *Ft* in any form	C1
	(impulse =) 2.4 N s	A1
(b)(ii)	*Ft = mv – mu* in any form OR *(v – u =) Ft / m*	C1
	43 m / s	A1
(b)(iii)	1 kinetic energy (of racquet) to elastic / strain energy (in ball or strings)	B1
	2. elastic / strain energy (in ball or strings) to kinetic energy (of ball)	B1

41. 0625_w18_ms_43 Q: 2

(a)	1st box: force	**B1**
	2nd box: impulse	**B1**
(b)(i)	**1** (p =) mv **or** 0.046 × 65	**C1**
	3.0 kg m/s **or** 3.0 Ns	**A1**
	2 (F =) $m(v - u) / t$ **or** 3.0 / 0.00050 **or** a = $(v - u) / t$ **and** F = ma **or** 0.046 × 65 / 0.00050 **or** 0.046 × 130 000	**C1**
	6000 N **or** 6000 N	**A1**
(b)(ii)	elastic (energy) **or** strain (energy)	**B1**

42. 0625_m17_ms_42 Q: 2

(a)	(Momentum) has direction OR Momentum depends on velocity and velocity is a vector	**B1**
(b)(i)	(Change of momentum =) mv – mu OR m Δv OR (-) mu OR (–)1200 × 7.5	**C1**
	(–) 9000 kg m/s or N s	**A1**
(b)(ii)	(F =) change of momentum / time OR m(v – u) / t OR mΔv / t OR 9000 / 0.36	**C1**
	25 000 N	**A1**
	OR	
	a = (v – u) / t OR (0 – 7.5) / 0.36 OR (–) 20.8 m/s^2	(C1)
	F = (ma OR 200 × 20.8 =) 25 000 N	(A1)
(c)(i)	½ m v^2 = 4.3 × 10^5	**C1**
	v^2 = 2 × 4.3 × 10^5 / 1500 OR v = (2 × 4.3 × 10^5 / 1500)$^{1/2}$	**C1**
	24 m/s	**A0**
(c)(ii)	Other parts of the car will deform / bend / break etc. OR more damage	**B1**
	Total:	**8**

43. 0625_s17_ms_41 Q: 2

(a)(i)	*Ft* OR 180 × 0.050	**C1**
	9.0 Ns OR 9.0 kg m / s	**A1**
(a)(ii)	*Ft* = *m*(*v* – *u*) OR *Ft* = *mv* – *mu* OR *Ft* = *mv* OR (m =) *Ft* / *v* OR 9.0 / 20	**C1**
	0.45 kg	**A1**
(a)(iii)	*mgh* = ½ *mv*^{2} OR (*h* =) *v*^{2}/2 g	**C1**
	(*h* =) 20^2 / (2 × 10)	**C1**
	20 m	**A1**
	OR *t* = *v* / g = 2	**(C1)**
	h = average speed × time	**(C1)**
	20 m	**(A1)**
2(b)	Elastic (energy) OR strain (energy)	**B1**
	Total:	**8**

44. 0625_s17_ms_42 Q: 3

(a)	'force and time'	**B1**
(b)(i)1.	(momentum =) mv	**C1**
	(momentum = 2.4 × 3 =) 7.2 kg m / s OR Ns	**A1**
(b)(i)2.	(m_A + m_B)v = m_A x 3 OR momentum conserved	**C1**
	(v = 7.2 / 3.6 =) 2.0 m / s	**A1**
(b)(i)3.	(impulse / Ft =) m(v – u)	**C1**
	(impulse / Ft = 1.2 × (2–0) =) 2.4 kg m / s OR N s	**A1**
(b)(ii)	thermal/sound energy (produced at collision/lost)	**B1**
	Total:	**8**

45. 0625_s17_ms_43 Q: 2

(a)	(momentum =)mass × velocity	**B1**
(b)(i)	(p =)3.2 × 4.0	**C1**
	13 kg m / s	**A1**
(b)(ii)	momentum conserved	**C1**
	12.8 – (3.2 × 1.5) OR 12.8 – 4.8 OR 8.0 OR 8.0 ÷ 1.6	**C1**
	5.0 m / s	**A1**
(c)	(F =) $\frac{\Delta p}{\Delta t}$ **or** 8.0 ÷ 0.050	**C1**
	160 N	**A1**
(d)	internal energy (of blocks) increase OR thermal energy/sound energy (lost/produced at collision)	**B1**
	Total:	**9**

46. 0625_w17_ms_42 Q: 3

(a)	suitable fuel for a power station	**B1**
	any **three** from five: • thermal energy / heat (from fuel) • water / steam / gas heated OR steam produced • (steam / gas) turns / moves / drives turbine • (turbine) turns / moves / drives generator • 2 correct energy transfers	**B3**
(b)	sun is energy source for plants / living matter (to grow) o.w.t.t.e.	**B1**
	plant / animal (remains compressed) into fuel OR carbon / chemical energy stored / trapped in plant / animal (remains)	**B1**
(c)	not renewable (as fuel is consumed)	**M1**
	could only be replaced over very long time period (e.g. clearly > 50 years)	**A1**

47. 0625_w17_ms_43 Q: 3

(a)(i)	nuclear fusion	**B1**
(a)(ii)	nuclei combine / join together	**B1**
	small nuclei to larger nuclei **or** hydrogen to helium (in some way) **or** loss of mass	**B1**
(b)	any suitable resource e.g. fossil fuels; hydroelectric; wave; wind	**M1**
	renewable **or** not (according answer) **and** matching explanation	**A1**
(c)	**two** advantages from: no polluting gases / quiet / low maintenance / can be placed on roofs / clean / cheap to run	**B2**
	two disadvantages from: intermittent supply / unattractive / takes up space / uses land / d.c. output	**B2**