Mark scheme

Momentum and impulse

Physics 0625 · Paper 4 (Extended)

Total marks

64

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	Total
5	5	6	7	7	8	9	8	9	**64**

Question 1 [5]

1(a)	(–) 3.5 kgm / s	**A2**
	(Δp =) $m(\Delta)u$ **OR** $m\{v - u\}$ **OR** 0.14 × {25 (– 0)}	C1
1(b)	360 N	**A3**
	0.0097 (s) **OR** 9.7×10^{-3} (s) **OR** 3.6×10^{n}	C1
	(F =) $(\Delta)p / t$ **OR** 3.5 / 0.0097	C1

Question 2 [5]

2(a)	(momentum is) mass × velocity	**B1**
2(b)(i)	1.9 N s **OR** 1.9 kg m / s	**A2**
	impulse = $F\Delta t = \Delta\{mv\}$**OR** (impulse =$F\Delta t$ =) $\Delta\{mv\}$ **OR** (impulse =) 0.046 × 41	C1
2(b)(ii)	3800 N	**A2**
	$F=\Delta p / \Delta t$ **OR** (F=) $\Delta p / (\Delta)t$ **OR** (F=) $\Delta(mv) / (\Delta)t$ **OR** (F =) impulse / $(\Delta)t$ **OR** 1.9 / 0.0005 **OR** 3.8×10^{N} N	C1

Question 3 [6]

3(a)	momentum before collision = momentum after collision	**B1**
	(initial momentum (p) =) 800 × 2 OR 1600 (kg m / s)	**B1**
	(v =) (1600 – 1300) / 800 OR 300 / 800 OR 0.38 (m / s)	**B1**
3(b)(i)	(impulse =) change in momentum	**C1**
	1300 Ns	**A1**
3(b)(ii)	same value as **(b)(i)** OR 1300 (Ns)	**B1**

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Question 4 [7]

4(a)	(statement momentum is) zero / 0 **AND** (explanation) momentum is mass × velocity **OR** the velocity (of B) is zero	**B1**
4(b)	1.1 kg	**A3**
	Conservation of momentum **OR** momentum after (collision) = momentum before (collision) **OR** {0.75 × 0.44} = {0.75 + m} × 0.18	C1
	momentum before collision = 0.75 × 0.44 (+ m ×0 = 0.33) **OR** momentum after collision = (0.75 + m) × 0.18	C1
4(c)(i)	0.13 N	**A2**
	(F =) $\Delta p \div (\Delta)t$ **OR** (0.75 + 1.1) × 0.18 ÷ 2.6 **OR** (F =) 0.33 ÷ 2.6 $(F =)\{0.75 + \mathbf{2(b)}\} \times 0.18 \div 2.6$	C1
4(c)(ii)	(time taken) Increases **AND** use of $F(\Delta)t = \Delta\{mv\}$ **OR** $F \propto 1 / (\Delta)t$ **OR** same momentum change required	**B1**

Question 5 [7]

5(a)	(momentum =) mass × velocity **OR** (p =) mv	**B1**
5(b)	(velocity =) 0.19 m / s **AND** (direction) to the right	**A4**
	(momentum before collision) = {0.45 × 0.34} – {0.21 × 0.12} **OR** 0.1278	C1
	(momentum after collision) = 0.66 × v	C1
	momentum before collision = momentum after collision **OR** {0.45 × 0.34} – {0.21 × 0.12} = 0.66 × v **OR** 0.153 – 0.0252 = 0.66 × v	C1
5(c)	(–) 0.12 N	**A2**
	$F\Delta t = \Delta\{mv\}$ **OR** (F =) $\Delta p \div (\Delta)t$ **OR** (F =) $\Delta\{mv\} \div (\Delta)t$ **OR** (F =) 0.26 ÷ 2.1	C1

Question 6 [8]

6(a)	(p =)mv **or** 2000 × 18	**C1**
	36000 kg m/s (**or** N s)	**A1**
6(b)(i)	15000 kg m/s (**or** N s)	**B1**
6(b)(ii)	15000 kg m/s (**or** N s) (e.c.f.**(i)**)	**B1**
6(b)(iii)	(F =)$p \div t$ **or** $mv \div t$ **or** 15000 ÷ 0.20 (e.c.f.**(i)**/**(ii)**)	**C1**
	75000 N	**A1**
6(c)	(increased time causes) decreased rate of: change of momentum / acceleration / deceleration / impulse ÷ time	**B1**
	smaller forces on people / less injury	**B1**

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Question 7 [9]

7(a)	momentum = mv	C1
	(=) 30 000 kg m / s OR N s	A1
7(b)(i)	impulse same as momentum change	C1
	27 000 kg m / s OR N s	A1
7(b)(ii)	F= impulse(mom ch) / t in any form OR impulse(mom ch) / t	C1
	(F=27 000 / 0.6 =) 45 000 N	A1
7(b)(iii)	momentum loss truck A same as momentum gain truck B / impulse	C1
	(final mom truck A=) candidate's **(a) –** candidate's **(b)(i)**	C1
	(v= 3000/6000 =) 0.50 m/s	A1
		Total: 9

Question 8 [8]

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

Question 9 [9]

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

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