PLKTYTC
2019 – 2020
Physics Mock Examination Papers 1B
Suggested Solutions

1.

(a) The vacuum reduces the energy loss from the liquid to the surroundings by conduction. 1A

(b) Energy supplied $E = VIt$

$= 50 \times 2.0 \times 1$ 1M

$= 100$ J 1A

(c) Energy absorbed by the liquid in one second = $mc(T_2 - T_1)$ 1M

$\therefore \quad mc(T_2 - T_1) = E$

$c = \dfrac{E}{m(T_2 - T_1)}$

$= \dfrac{100}{0.01(30-25)}$ 1M

$= 2000$ J kg^{-1} °C^{-1} 1A

The specific heat capacity of the liquid is 2000 J kg^{-1} °C^{-1}.

(d) By radiation 1A

(e) R should be adjusted to a larger value. 1A

2.

(a) As the balloon moves up, its volume increases. 1A

(b) By the general gas law,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{P_2}{T_2} = \frac{P_1V_1}{T_1V_2}$$

$= 350 \times \dfrac{4}{35}$ 1M

$= 40$ Pa K^{-1} 1A

From the graph, the maximum height is 18 000 m. 1A

(c) By $PV = \dfrac{1}{3}Nm\overline{c^2}$,

$$\overline{c^2} = \sqrt{\frac{3PV}{Nm}}$$

$$= \sqrt{\frac{3V}{Nm} \times \frac{P}{T} \times T}$$

$= \sqrt{\dfrac{3 \times 35}{0.656} \times 40 \times (273 - 56)}$ 1M

$= 1180$ m s^{-1} 1A

The root-mean-square speed of helium molecules is 1180 m s^{-1}.

3.

(a) **(i)** Consider the stopping of the recoiling cannon by friction.

By $s = \frac{1}{2}(u+v)t$, — 1M

$u = \frac{2s}{t} - v$

$= \frac{2 \times 0.3}{0.4} - 0$

$= 1.5 \text{ m s}^{-1}$

The initial recoil speed of the cannon is 1.5 m s^{-1}. — 1A

(ii) Take the direction towards the right as positive.

By conservation of momentum,

$0 + 0 = m_c v_c + m_b v_b$ — 1M

$0 = 500 \times (-1.5) + 5.5 v_b$

$v_b = 136 \text{ m s}^{-1}$

The horizontal speed of the cannonball is 136 m s^{-1}. — 1A

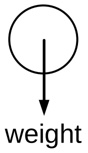
(b) (i) Take the upward direction as positive.

Vertical speed of the cannonball = 136 tan30°

= 78.7 m s^{-1} — 1A

(ii)

(Correct force)



1A

(iii) Consider the vertical motion of the cannonball.

By $s = ut + \frac{1}{2}at^2$,

$-1.2 = 78.7t + \frac{1}{2} \times (-9.81)t^2$ — 1M

$4.905t^2 - 78.7t - 1.2 = 0$

t = 16.1 s — 1M

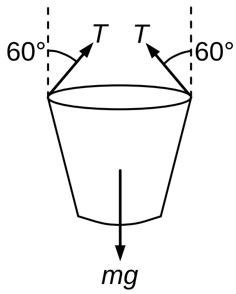
Range = horizontal distance travelled by the cannonball

= 136 × 16.1

= 2.19 × 10^3 m — 1A

4.

(a)



The net force acting on the bucket is zero.

$\therefore \quad 2T\cos 60^\circ = mg$ — 1M

$$T = \frac{mg}{2\cos 60^\circ}$$
$$= \frac{(1.2+15)\times 9.81}{2\cos 60^\circ}$$
$$= 159 \text{ N}$$

The tension of each of the thin ropes is 159 N. — 1A

(b) **(i)** By $F = ma$,

Let T' be the tension of the thick rope.

$T' - mg = ma$ — 1M

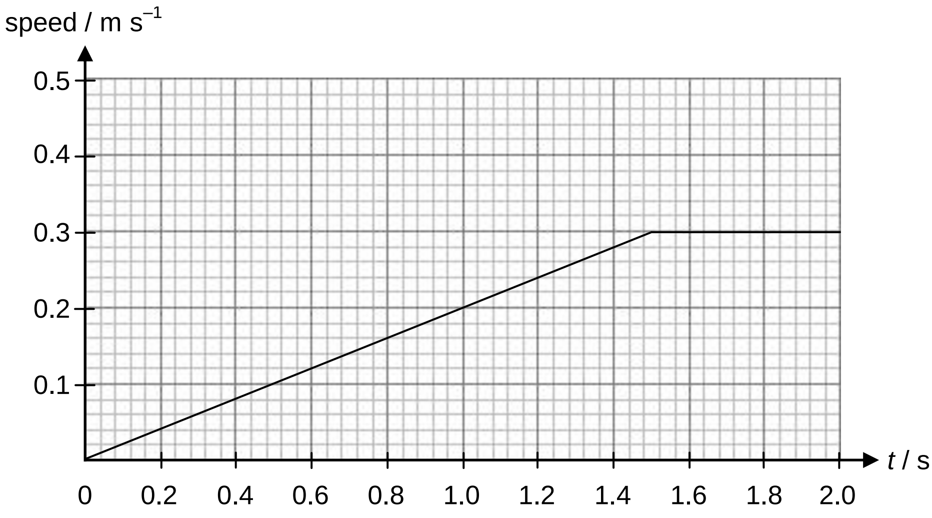
$T' = m(g + a)$

$= (1.2 + 15) \times (9.81 + 0.2)$

$= 162$ N

The tension of the thick rope is 162 N. — 1A

(ii)



Shape corret — 1A

All correct — 1A

(iii) By $P = Fv$,

$P = mgv$

$= (1.2 + 15) \times 9.81 \times 0.3$ — 1M

$= 47.7$ W

The power provided is 47.7 W. — 1A

5.

Stick the paper strip onto the horizontal part *BC* of the track. ✓1A

Release the toy from a certain height *h* from the bench surface and measure the corresponding stopping distance *d*.

Stopping distance should be measured from the beginning of the horizontal part *BC* or on the paper strip. ✓1A

Release the toy from different heights and measure the corresponding stopping distances. ✓1A

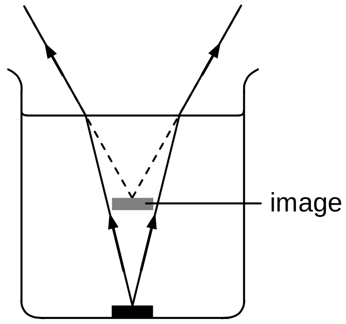
Plot a graph of *d* against *h*, ✓1A

a straight line passing through origin should be obtained ✓1A

5

6.

(a) **(i)**



Two correct refracted rays (bent away from normal) 1A

Correct image location 1A

the image drawn with dotted lines 1A

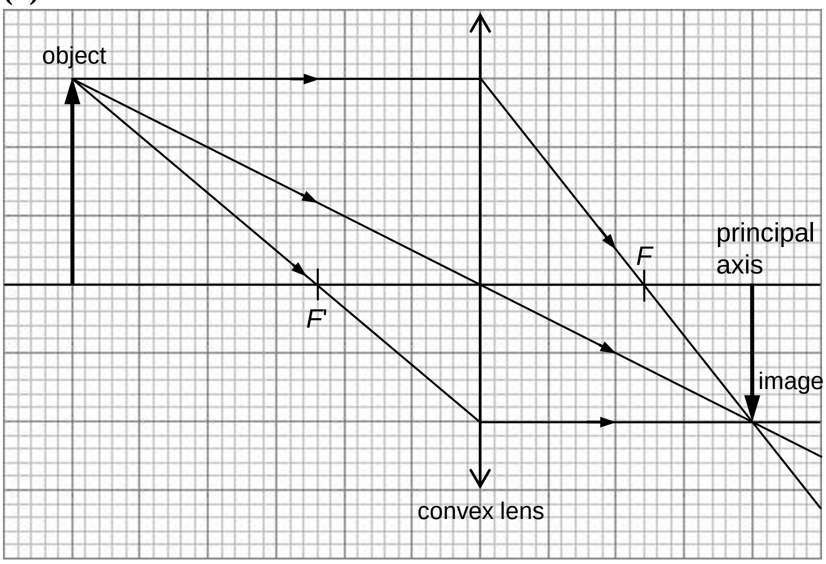
(ii) The image forms at a lower position under the liquid surface 1A

because refracted rays bend less away from normal. 1A

(b) **(i)** Convex lens 1A

This is because the image is inverted. 1A

(ii)



(At least 2 correct light rays — No marks for dotted lines or with wrong/no direction) 1A

(Correct position of the lens) 1A

(Correct positions of the two foci *F* and *F'*) 1A

7.

(a)	**(i)**	Constructive interferences occur at the centre of fringe P	1A
		and at the centre of fringe Q.	1A
	(ii)	Path difference at the centre of fringe P = 0λ (or 0)	1A
		Path difference at the centre of fringe Q = λ	1A
(b)		Wavelength $\lambda = \dfrac{v}{f} = \dfrac{3\times10^{8}}{4\times10^{14}}$	1M
		$= 7.5 \times 10^{-7}$ m	1A
(c)		The fringe separation will decrease.	1A
(d)		The light source should be strong (or the laboratory should be dark).	1A
		All slits should be narrow.	1A

8.

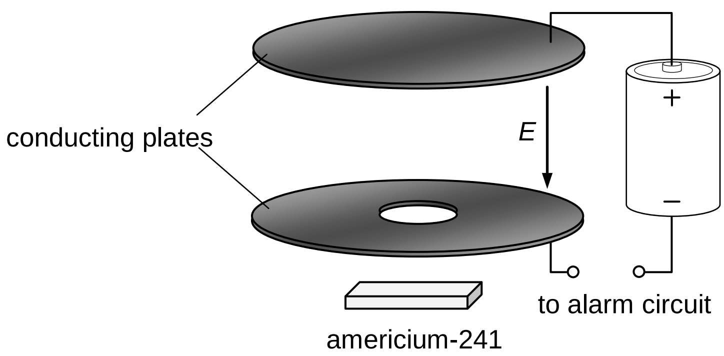
(a)	$P = \dfrac{V^2}{R}$	
	$1000 = \dfrac{220^2}{R}$	1M
	$R = 48.4\ \Omega$	1A
	The resistance of a lamp is 48.4 Ω.	
	As the lamps on a light post are connected in parallel,	
	$\dfrac{1}{R_{eq}} = 9\times\dfrac{1}{R}$	
	$\dfrac{1}{R_{eq}} = \dfrac{9}{48.4}$	1M
	$R_{eq} = 5.38\ \Omega$	1A
	The resistance of the light post is 5.38 Ω.	
(b)	Resistance of cable $= \dfrac{\rho l}{A}$	
	$= \dfrac{(1.7\times10^{-8})\times240}{2.5\times10^{-6}}$	1M
	$= 1.63\ \Omega$	1A
(c)	Let n be the number of light post that can be connected in a lighting circuit.	
	By $V = IR$,	
	$220 = 70 \times (\dfrac{5.38}{n} + 1.63)$	1M
	$n = 3.56$	
	∴ At most 3 light posts can be connected in a lighting circuit.	1A
(d)	The lamps are not working at their rated voltage as there is voltage drop through the long cable.	1A

9.

(a)		When the magnet approaches the solenoid, the induced current flows from P to Q through the solenoid.	1A
		When the magnet moves inside the solenoid, no current is induced in the solenoid.	1A
		When the magnet leaves the solenoid, the induced current flows from Q to P through the solenoid.	1A
(b)	**(i)**	$P \rightarrow A \rightarrow B \rightarrow R \rightarrow S \rightarrow D \rightarrow C \rightarrow Q$	1A
	(ii)	$Q \rightarrow C \rightarrow B \rightarrow R \rightarrow S \rightarrow D \rightarrow A \rightarrow P$	1A
(c)	**(i)**	Apply $E = Pt$.	
		Energy generated by shaking the flashlight for 30 s = energy dissipated by lamp in 5 min	
		$P \times 30 = 100 \times 10^{-3} \times 5 \times 60$	1M
		$P = 1$ W	1A
		The average power of the generator is 1 W.	
	(ii)	No. The lamp is powered by the battery and has constant brightness.	1A
		Shaking the flashlight more vigorously will only charge the battery more quickly.	1A
	(iii)	Peak value of induced e.m.f. $= N \dfrac{\Delta \Phi}{\Delta t}$	
		$= 330 \times 0.0133$	1M
		$= 4.39$ V	1A
		r.m.s. value of the induced e.m.f. $= \dfrac{4.39}{\sqrt{2}} = 3.10$ V	1A

10.

(a)



1A

(b)	${}^{241}_{95}\text{Am} \rightarrow {}^{237}_{93}\text{Np} + {}^{4}_{2}\alpha$	2A
Or	${}^{241}_{95}\text{Am} \rightarrow {}^{237}_{93}\text{Np} + {}^{4}_{2}\text{He}$	2A
(c)	The negative electrons are attached to the smoke particles instead of the positive conducting plate.	1A
	This causes the current between the plates to drop and triggers the smoke alarm.	1A
(d)	Activity $= A_0 e^{-kt}$	1M
	$= (3.33 \times 10^4) \times e^{-\frac{\ln 2}{432} \times 10}$	1M
	$= 3.28 \times 10^4$ Bq	1A