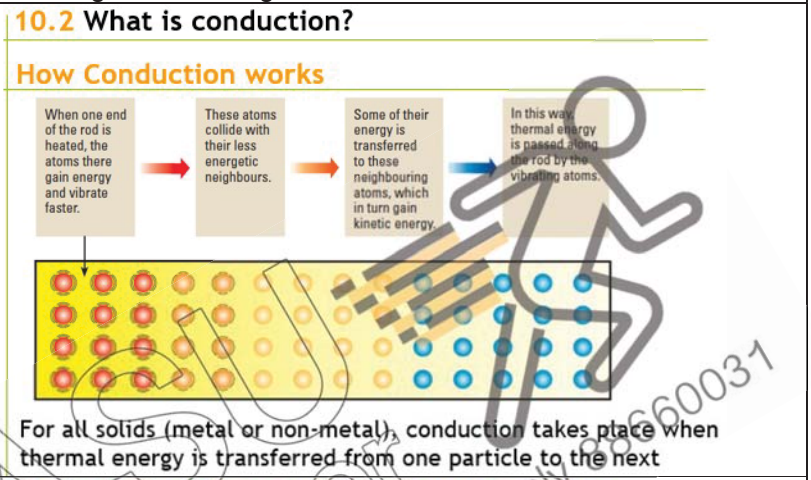
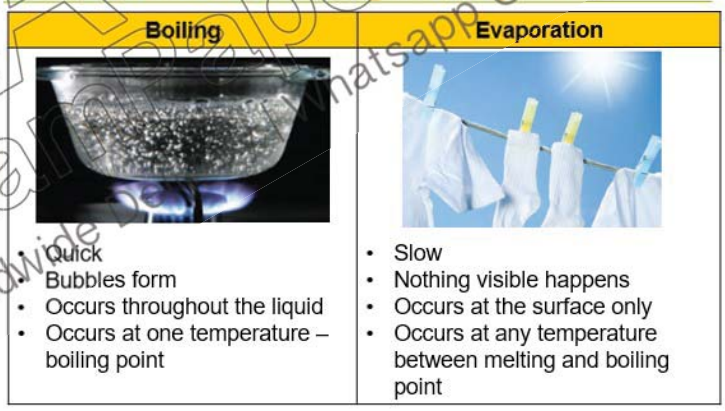
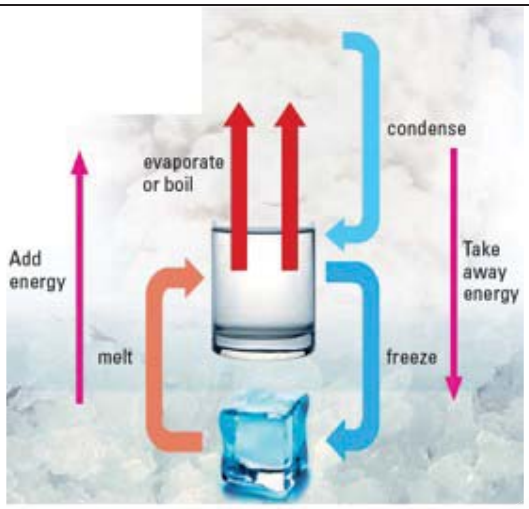
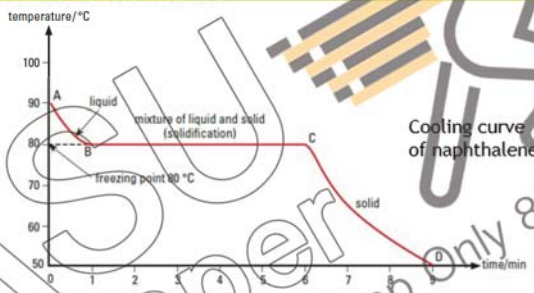
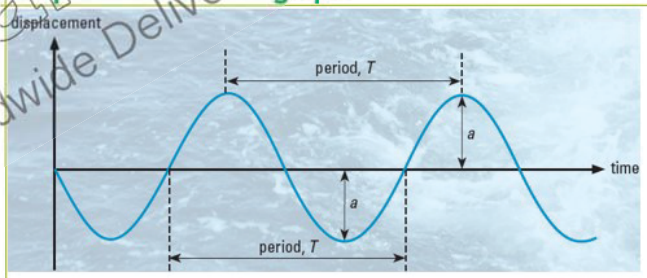
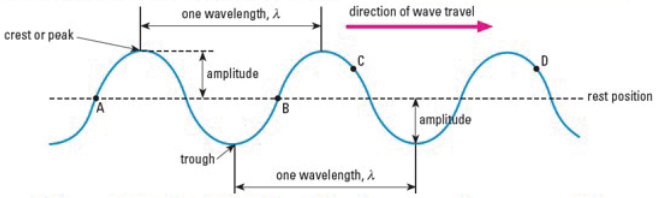
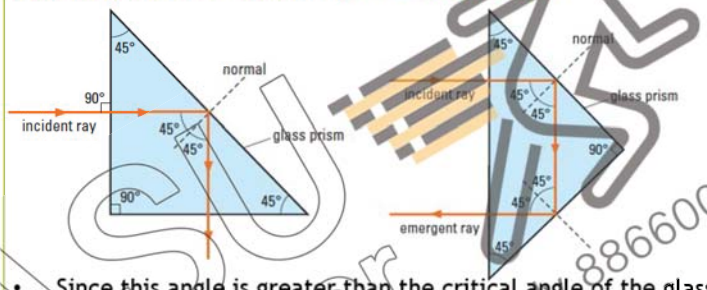
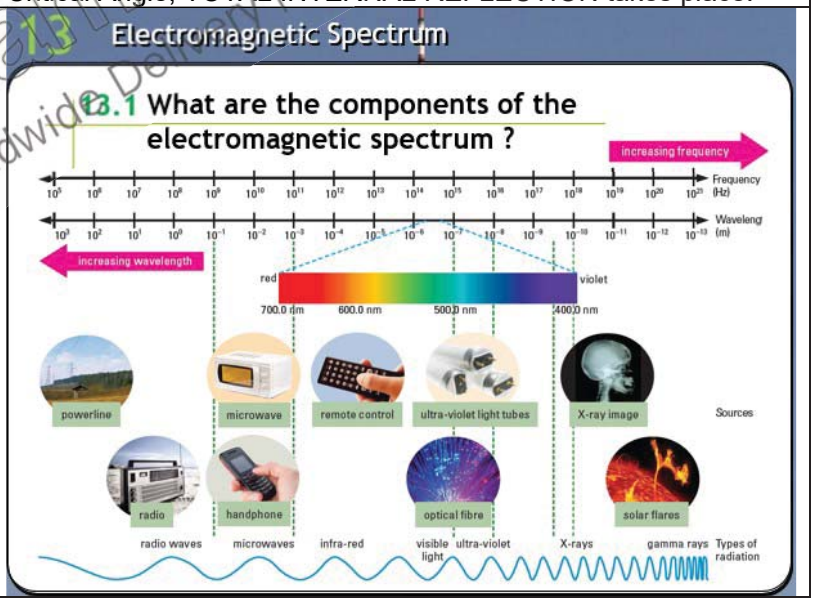
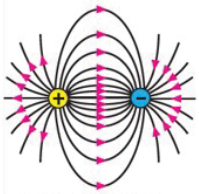
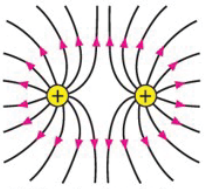
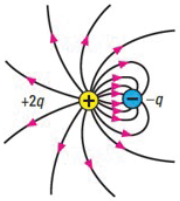
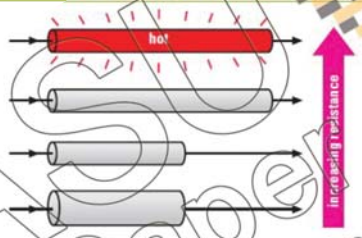
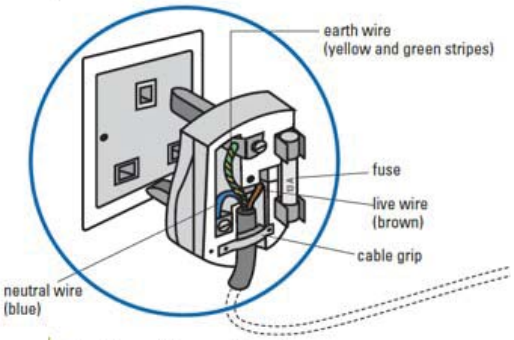
Answer Scheme
GAN ENG SENG SCHOOL
Prelim Examination 2020
ScPHYSICS (Sec 4Exp5NA SciPhy)
Paper 1 Multiple Choice, 5076/01

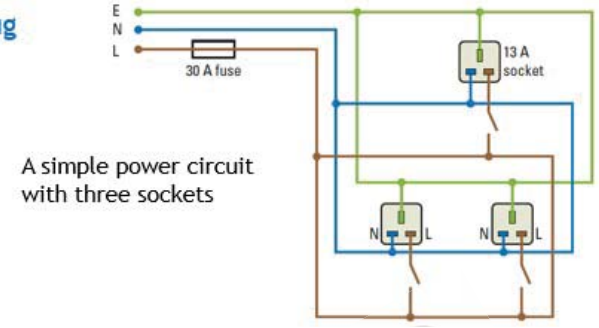
Question	Answer	Explanation
1	B	Reading on micrometer is 0.5 mm +0.02 mm = 0.52 mm The paper is folder twice. So the measured thickness is 4 sheets of paper. Therefore thickness of ONE sheet of paper = 0.52/4 = 0.13 mm
2	B	The steepest gradient will have the greatest acceleration.
3	A	For the Newton-meter (Spring Balance), it measure weight (W=mg) which will be dependent on the "g" of Earth and Moon. For the "scales", it measure mass. Mass is the same whether the object is on Earth or the Moon.
4	C	Density = mass/ volume **Cylinder** $\pi r^2 h$ where r = radius, h = height **Sphere** $\frac{4}{3}\pi r^3$ where r = radius **Cuboid** lwh where l = length, w = width, h = height **Hollow Cylinder** $\pi h(R^2 - r^2)$ where R = radius of the outer surface, r = radius of the inner surface $V_A = \pi \times 6^2 \times 5 = 565.49\ cm^3$ $V_B = (4/3) \times \pi \times 10^3 = 4188.8\ cm^3$ $V_C = 8 \times 6 \times 5 = 240.00\ cm^3$ $V_D = \pi (15^2 - 10^2) \times 20 = 7853.98\ cm^3$ Density = mass / volume $\rho_A = 800 / 565.49 = 1.42\ g / cm^3$ $\rho_B = 5400 / 4188.9 = 1.29\ g / cm^3$ $\rho_C = 1200 / 240 = 5.00\ g / cm^3$ $\rho_D = 9000 / 7853.98 = 1.15\ g / cm^3$

5	D	The Centre of Gravity will be raised, hence the stability will decrease. The inertia will increase as the mass increases.
6	D	$P = F / A$ $2.0 \times 10^{6} = F / 0.02$ $F = 2.0 \times 10^{6} \times 0.02$ $= 40\,000$ N This is the force on ONE tyre. There are 4 tyres. Total Force = 40 000 x 4 = 160 000 N This is also the Weight of the car. Note that the Unit of measure for Weight is N, not kg.
7	D	
8	D	

9	D	 Changes of state **10.2 What happens when there is a change of state?** **Melting and Freezing** 
10	B	A rough , dull black surface is a better emitter of infra-red radiation than a smooth, bright shiny surface
11	D	**11.4 How do graphs describe waves?** **Displacement-time graph**  • If we look at the motion of a single particle at a particular position as the wave passes, we are looking at the displacement of the particle as time changes • The picture above shows a displacement-time graph and we can determine the amplitude and period of the wave $T = \frac{1}{f}$ For high frequency, the Period T will be short.

12	B	**11.3 What are the terms used to describe waves?** **Description of wave motion**  • The period, T, is the time taken to generate one complete wave. It is also the time taken for the crests, or any given point on the wave, to move a distance of one wavelength. $T = \frac{1}{f}$
13	A	**12.2 What happens when light passes from one medium to another?** **Applications of Total Internal Reflection**  • Since this angle is greater than the critical angle of the glass prism, they are internally reflected • Prisms like these are used in periscopes and binoculars Since the angle is incident is 45 degree which is more than the Critical Angle, TOTAL INTERNAL REFLECTION takes place.
14	C	

15	A	**15.2** What is an electric field?  (a) The electric field lines for two point charges of equal magnitude but opposite signs  (b) The electric field lines for two equal positive point charges  (c) The electric field lines produced by charge +2q and charge -q. Notice that the number of lines leaving charge +2q is twice the number of lines
16	D	laws of electrostatics which state that like charges repel and unlike charges attract. P and Q repel each other. Q and R repel each other R and S attract each other
17	C	16.4 What is resistance? **Factors Affecting Resistance**  How size and temperature affect resistance of a wire • The other two factors which affect the resistance are the length and the thickness of the wire 1. A long wire has more resistance than a short wire 2. A thin wire has more resistance than a thick wire
18	D	Cost of electricity = kW x h x rate ($) of electricity =[(3 x 2) + (2 x 4)] x 23 = (6 + 8) x 23 = 322 cents
19	A	 Inside a three-pin plug Live wire : brown Neutral wire : blue

		Earth wire : yellow and green stripes Live = 10 A Neutral = 10 A Earth = 0 A
20	A	Three-pin plug  Switches and Fuses – always connect to LIVE wire.

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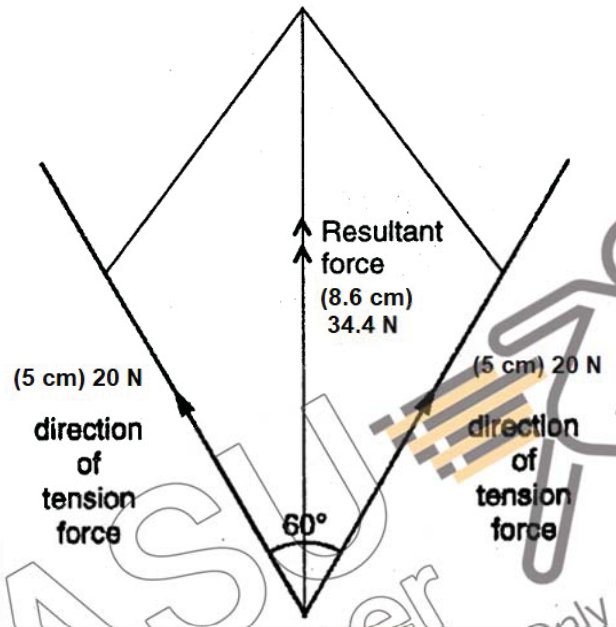
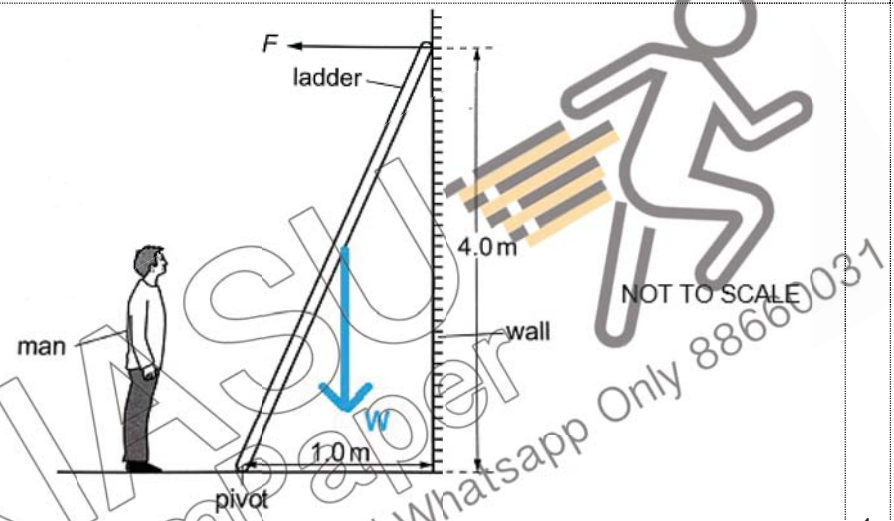
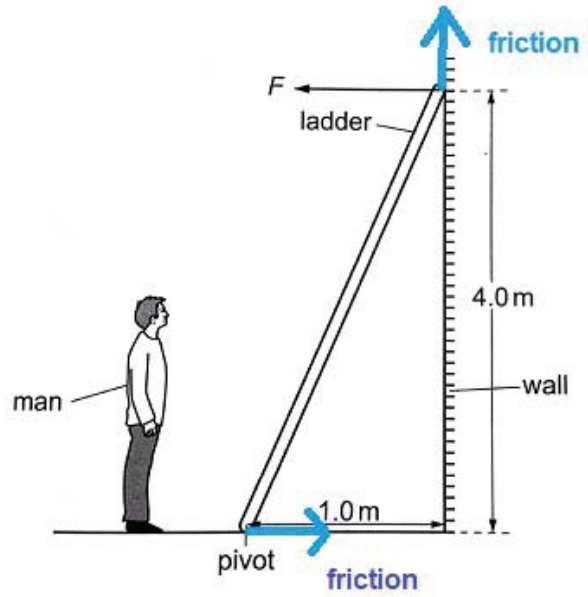
PAPER 2

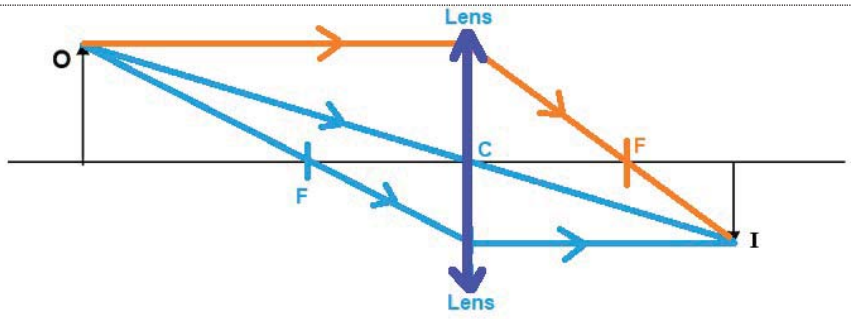
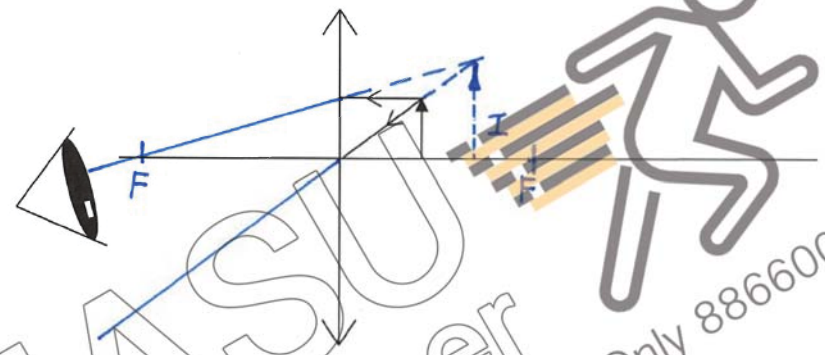
Q No.		Answer and Marking Scheme		Total marks
1		 Construction of parallelogram Resultant force = 34.4 N [acceptable 33.2 to 35.6 N] Direction of resultant force correctly indicated	1 1 1	3
2	a	Resultant Force = 0 N [comment: during the driver's reaction time, the speed is constant. When the speed is constant, the Resultant force on the car is zero.]	1	1
	b	Braking distance = Area under the speed-time graph = 0.5 x (3.0 – 0.8) x 50 = 55.0 m	 1	1
	c	acceleration = gradient of the graph = (0 – 50)/ (3.0 – 0.8) = - 22.7 m/s^2 Deceleration = 22.7 m/s^2	 1 1	2
	d	Resultant force = ma = 850 x 22.7 = 19,295 N = 19 300 N (to 3 S.F) [no ECF]	 1	1
3	a	L = 10 kN – 4 kN = 6 kN M = 5 kN [comment: note that the car is travelling ar CONSTANT VELOCITY. This means that the Net or Resultant force on the car is Zero – in the horizontal direction. This fact is used to find the force M.]	1 1	2

	b	W = mg where m is the mass of the car. m = W g m = 10 000 / 10 = 1000 kg Using F = ma L – 2M = ma 5000 – 10 000 = 1000 x a - 5000 = 1000a a = - 5 m / s^2 [accept 5 m/s^2 - if student define left is positive direction]	 1 1 1	3
4	a	The molecules **move among** one another **throughout the liquid**. The molecules move **randomly** at **high speed**.	1 1	2
	b	The **intermolecular forces** of attraction between each gas molecules are negligible or very **weak**. Therefore, the molecules are free to move about within the container and gases do not have a fixed shape. Since the intermolecular forces are weak, the molecules are **far apart** as well. This means that gases do not have fixed volume as they can be **compressed easily** since there is a lot of **space** between them	1 1	2
5	ai	To minimise heat loss by conduction.		1
	aii	As dark-coloured is a **good absorber** of thermal radiation, thermal energy is absorbed by the copper pipes at a faster rate. As copper is a **good conductor** of heat, thermal energy is transferred from the copper to the fluid more effectively.	1 1	2
	b	As the copper molecules gain thermal energy from the sun, it gains kinetic energy and **vibrates faster** about its fixed position. These molecules collide with their less energetic neighbouring molecules and some of their energy is **transferred** to them. Copper also contains **free electrons**. When heated, free electrons **gain energy and move faster**. These free electrons are free to travel in the spaces between the molecules before colliding with other electrons and molecules and **transferring** some of their energy to them. These processes continue until the transfer of energy reaches the opposite end of the copper and the energy is transferred to the fluid in the pipe.	1 1	2
	c	As hot water is less dense than cold water, hot water rise and cold water sink. The position of the inlet and outlet is to ensure even distribution of the hot water (due to convection currents) in the water tank.	1 1	2
	d	If the freezing point is **too high**, the **fluid might freeze** if the temperature of the surrounding drops and the system will not be able to function.	`	1

6	a	$n = \frac{c}{v}$ $= \frac{3.0 \times 10^8 \text{ m s}^{-1}}{1.9 \times 10^8 \text{ m s}^{-1}}$ = 1.58	1 1	2
	b	$\sin c = \frac{1}{n}$ $= \frac{1}{\left(\frac{3.0 \times 10^8 \text{ m s}^{-1}}{2.4 \times 10^8 \text{ m s}^{-1}}\right)}$ c = 53.1 ° (shown)	1	1
	c	$n = \frac{\sin r}{\sin i} \Rightarrow \sin r = n \sin i$ $= \left(\frac{3.0 \times 10^8 \text{ m s}^{-1}}{2.4 \times 10^8 \text{ m s}^{-1}}\right) \sin(90° - 60°)$ r = 38.7 °	1 1	2
	d	The angle of incidence (90° – 36° = 54°) is larger than the critical angle of 53.1° thus total internal reflection occurs and this ray does not leave the water surface.	1 1	2
7	a	20 waves are produced in 1 second.	1	1
	b	v = fλ λ = v / f For shortest wavelength, use f = 20 000 Hz λ = 340 / 20 000 = 0.017 m	1 1	2
8	a	Resistance from parallel lines, R = - R = 2 Ω Total Resistance, 2 + 4 = 6 Ω	1 1	2
	b	V = RI 12 = (6)(I) I = 2 A [ECF from (a)]	1	1
	c	Q = It Q = (2)(120) Q = 240 C [No ECF allowed from (b)]	1	1
	d	V = RI V = (2)(2) [comment: R = 2 ohms: from the parallel resistor of 3 ohm and 6 ohm] V = 4 V	1	1

		or Pd through 4 Ω resistor Using V = RI V = (4)(2) = 8 V [no ECF allowed] Voltmeter reading: 12 – 8 = 4 V		
9	a	P = V I 1680 = 240 / I I = 1680 / 240 = 7 A	 1 1	2
	b	10 A fuse	1	1
	ci	live wire: 240 V	1	1
	cii	earth wire: 0 V	1	1
		Section B		
10	a	 [A line drawn vertically downwards through the centre of the ladder] perpendicular distance = 0.50 m	 1 1	2
	b	Taking moment about pivot, sum of ACW moments = sum of CW moments F x 4 = 110 x 0.5 F = 13.8 N	1 1 1	3
	c	F increases as there is now an additional force with a moment opposing the moment of F. And the moment (due to the man) increases as he gets further away from the pivot	1 1	2

	d	 [correct direction shown, one arrow 1 M] add rubber to the feet of the ladder / make the ladder more upright / have someone hold the ladder (accept any sensible answer)	1 1 1	2+1
11	ai	Maximum potential energy : A or C [Accept A and C]	1	1
	aii	Maximum kinetic energy : B	1	1
	b	Gain in gravitational potential energy = mgh = 0.25 x 10 x 0.04 = 0.1 J	 1 1	2
	c	Maximum kinetic energy = Maximum gravitational potential energy $\frac{1}{2}mv^2 = 0.1$ $\frac{1}{2}(0.25)v^2 = 0.1$ $v^2 = \frac{0.2}{0.25}$ $v = \sqrt{\frac{0.2}{0.25}}$ ≈ 0.894 m/s (to 3 s.f.) Maximum speed = 0.894 m/s	1 1	2
	d	Period = 0.4 x 4 = 1.6 s	 1	1
	e	Force required to lift 20 people = 20 x 60 x 10 = 1200 N P $= \frac{W}{t}$ (where W is the Work Done (or Energy)) $= \frac{20\times60\times10\times5}{1\times60}$ = 1000 W	1 1 1	3

12	ai	 [light rays drawn with arrow to indicate position of lens] [light rays drawn wit arrows to indicate position of principle focus]	1 1	2
	aii	[Refer to diagram in ai – C is marked]	1	1
	aiii	[Refer to diagram in aii – F is marked [note either one or both is acceptable]	1	1
	b	Difference: Image is now magnified instead of diminished. Similarity: Image is still real or inverted.	1 1	2
	ci		1	1
	cii	[refer to diagram in ci]	1	1
	ciii	Virtual (or Not real) Upright ~~Magnified~~	1 1	2