Sample A Sec 3 EOY Exam Answer Key

Whole paper: Subtract 1 mark for improper presentations.

Subtract 1 mark for any number of sf mistakes.

Subtract 1 mark for any number of unit mistakes.

Paper 1

1	**C**	11	**D**	21	**A**
2	**D**	12	**D**	22	**B**
3	**C**	13	**D**	23	**C**
4	**D**	14	**A**	24	**A**
5	**D**	15	**A**	25	**D**
6	**C**	16	**B**	26	**D**
7	**D**	17	**A**	27	**B**
8	**C**	18	**C**	28	**A**
9	**C**	19	**A**	29	**D**
10	**A**	20	**C**	30	**D**

Paper 2

1(a) Zero error = - 0.02 mm [1]

Corrected reading = 3.77 mm – (- 0.02 mm)

= 3.79 mm [1]

Award 1 mark (process mark) if only observed reading is correct (3.77 mm)

(b) Mass = 0.0152 / 10

= 0.00152 kg [1]

Vol = 3.14 x $(3.79 / 2 \times 1000)^2$ x 3.00

= 3.38 x 10^{-5} m^3 [1]

Density = 0.00152 kg / 3.38 x 10^{-5} m^3

= 45.0 kg / m^3 [1 – ecf for calculation of density]

2(a) $\theta = \sin^{-1}(1/1.47)$

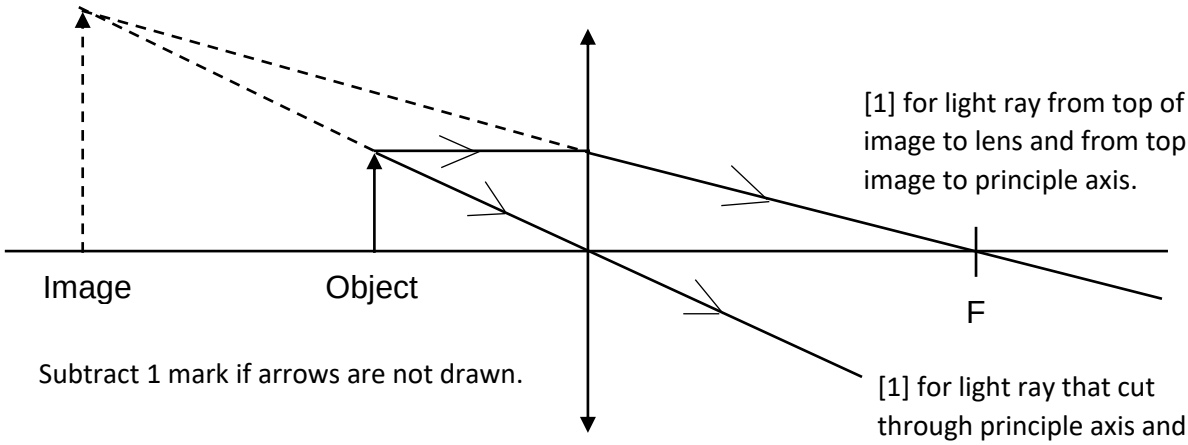
= 42.9º [1]

Diameter = 2 x (80 x tan 42.9º)

= 1.5 x 10^2 mm [1]

(b) The 'halo' diameter would be larger [1] as the critical angle increased [1].

3)



[1] for light ray from top of image to lens and from top of image to principle axis.

Subtract 1 mark if arrows are not drawn.

[1] for light ray that cut through principle axis and lens.

(a) Magnification factor = 3.0 cm / 1.2 cm = 2.5 (2.3 to 2.7) [1]

(b) Focal length = 4.0 cm (+ / - 0.4 cm) [1]

4(a) $v^2 = u^2 + 2as$

$0 = 15^2 + 2(-10)s$ [1]

$s = 11.25$ m

$= 11$ m [1]

(b) $t_1 = (0 - 15) / (-10) = 1.5$ s

$s = ut + 0.5at^2$

$t_2 = \sqrt{[(11.25 + 80) / 5]} = 4.3$ s [1] for correct calculation for t_1 and t_2

$t = t_1 + t_2 = 5.8$ s [1]

or

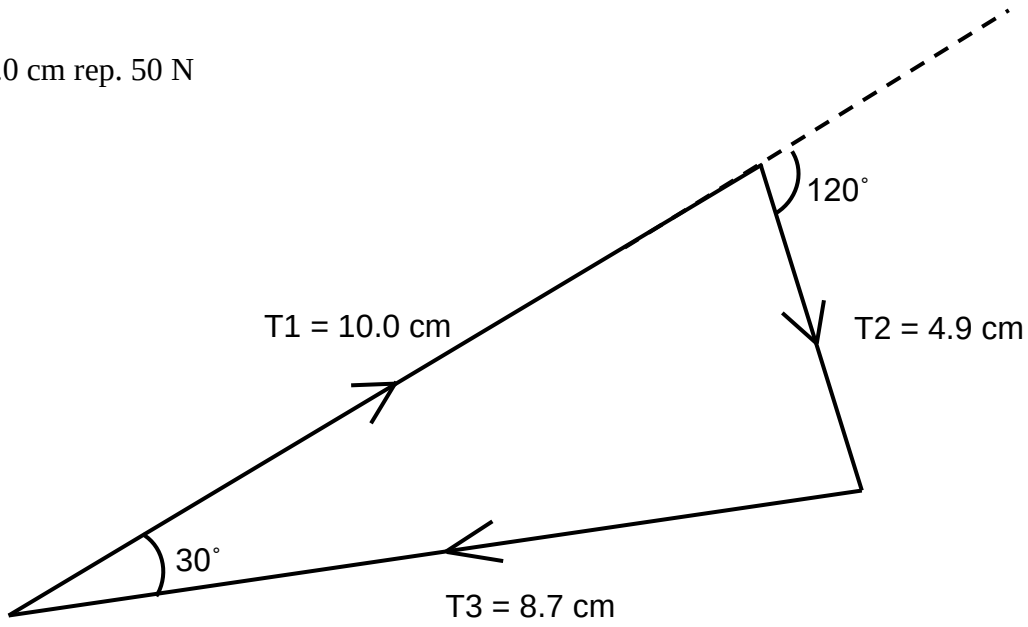
$s = ut + 0.5at^2$

$80 = -15t + 5t^2$ ***or*** $-80 = 15t - 5t^2$ [1]

$t = 5.8$ s [1]

5)

Scale: Let 1.0 cm rep. 50 N



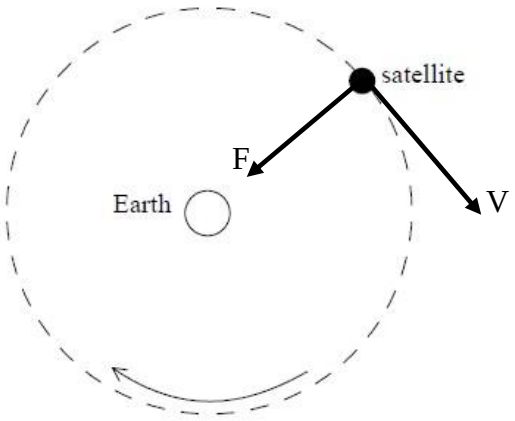
Team 2 tension = 4.9 x 50 = 245 N (+ / - 10 N) [1]

Team 3 tension = 8.7 x 50 = 435 N (+ / - 10 N) [1]

Correct vector diagram drawn [1]

Appropriate scale used – diagram occupy at least half of given space [1]

6a(i)(ii)



[1] – F drawn as a straight line towards centre of the Earth.

[1] – V drawn as a tangent to the position of the satellite.

(b) The direction of the satellite is changing all the time [1] and this means that its velocity is changing. A change in velocity [1] denotes that the satellite is accelerating.

(c) The direction of the moving satellite is always normal / at right angle to the force [1]. Therefore, no work is done [1].

7(a) The water is changing phase / boiling / kinetic energy of molecules is constant while potential energy is changing. [1]

(b) Energy supplied = 300 W x 420 s = 126 kJ

126 kJ = 0.40 x 4.2 x 10^3 x ΔT [1]

$\Delta T = 75^{\circ}C$

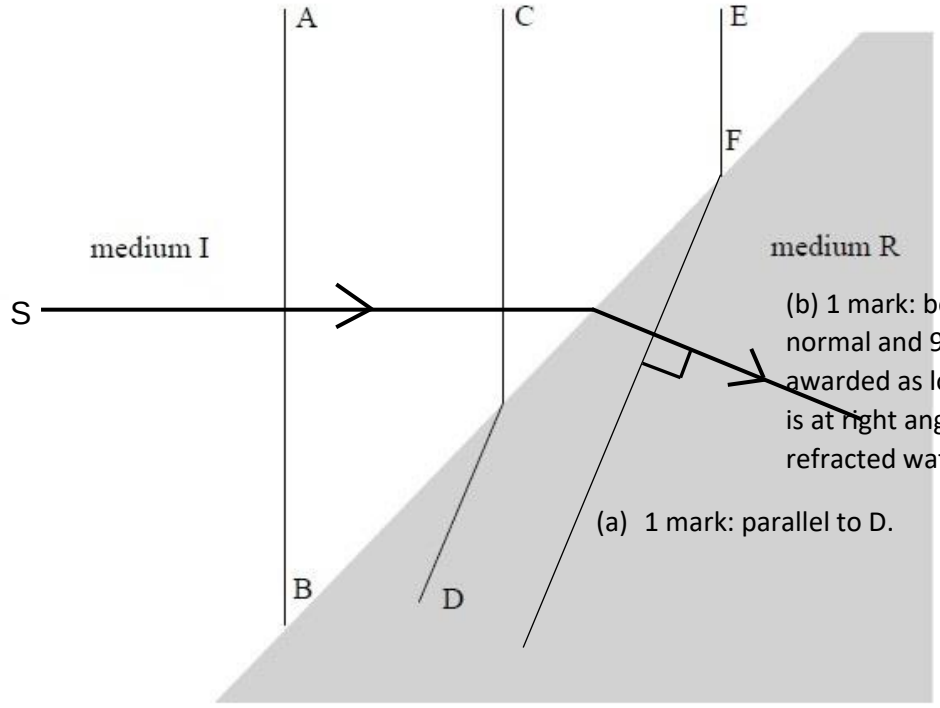
therefore, boiling temperature = 75 + 20 = 95˚C [1]

8(a) Temp = (804-802) x 100 / (815- 802) [1]

= 15.4˚C [1]

(b) Y [1]. Thermal energy will take a longer time to pass through the thicker glass bulb wall of Y, compared to X [1].

9(a)(b)



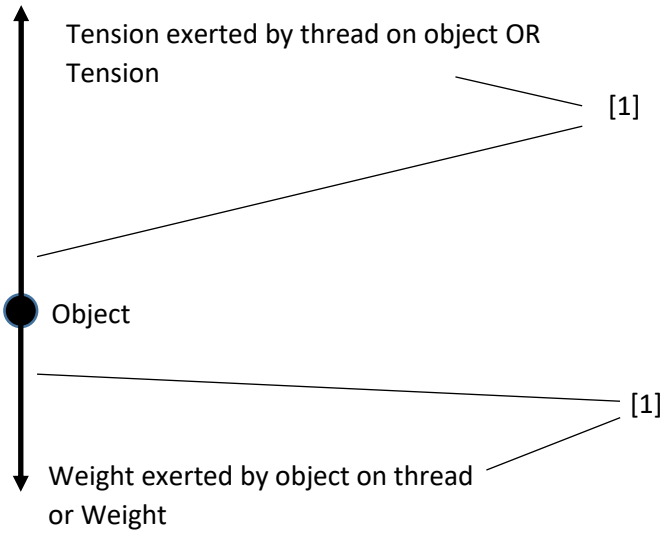
(b) 1 mark: bend towards normal and 90˚ to (a). Ecf awarded as long as wavefront is at right angle to direction of refracted water wave.

(a) 1 mark: parallel to D.

(c) Since the wavelength is larger in medium I [1], the speed of light is higher in medium I [1]; or the angle of incidence is larger than the angle of refraction [1], the speed of light is higher in medium I [1].

(d) $v_I / v_R = \lambda_I / \lambda_R =$ 2.9 cm / 1.5 cm [1 awarded: 2.9 cm for numerator and denominator is based on their wavelength measured in medium R]
= 1.9 (+ / - 0.1) [1]

10(a)(i)



Subtract 1 mark if tension is not drawn longer than weight.

(a)(ii) $s = ut + 0.5at^2$
$s = 0.5at^2$
$a = 2s/t^2$
$= (2 \times 0.84) / (2.2)^2$
$= 0.35 \text{ m s}^{-2}$ [1]
$T - mg = ma$
$T = m (g + a)$
$= 0.015 (10 + 0.35)$ [1]
$= 0.16 \text{ N}$ [1]

Award 1 mark only if a is calculated wrongly but the process for T is correct.

(b)(i) Increase in potential energy = $(0.015 \text{ kg})(10 \text{ m s}^{-2})(0.84 \text{ m}) = 0.13 \text{ J}$ [1]
Power = Work done / time = 0.126 J / 3.4 s = 0.037 W [1]
(ii) Power input to motor = VI = (6.0 V)(0.045 A) = 0.27W [1 - ecf]
Efficiency = P_{out} / P_{in} = (0.03706 W / 0.27 W) x 100% = 14% [1 - ecf]
(iii) The efficiency will be higher as the frictional force will be reduced / less energy will be lost [1 mark for both points].

11(a)(i) The pressure rises [1] above atmospheric pressure as the temperature rises due to increase in kinetic energy of the particles. As the pressure increases, the boiling point of water rises hence the water can reach a higher temperature [1].

(ii) The weighted vent was stuck / fail to open / hole was stuck with food. [1]
* Either one reason is accepted.

(iii) The high temperature caused the alloy plug to melt [1]. Some gas molecules inside the pressure cooker escape into the air / the rate at which the gas molecules hit the wall of the cooker decreases [1].

(b)(i) Gas molecules are moving randomly all the time, bombarding the walls of the cylinder with a force [1]. Since pressure is defined as force per unit area [1], the gas exerts a pressure on P.

(ii) The piston moved to the right [1] when it was heated up as the particles gained average kinetic energy [1] and hit the wall with a greater force / pressure [1].

12A(a) Transverse wave / Travel at speed of light in vacuum / are electromagnetic radiation / travel through vacuum / can be reflected, refracted, polarized, etc – any one of the mentioned. [1]

(b) Power = $0.36 / (3.0 \times 60) = 2.0 \times 10^{-3}$ W [1]
SAR = 2.0×10^{-3} W / 0.010 kg
= 0.20 W/kg [1]

If calculation was made without following the correct units, award only 1 mark.

(c) It is converted into thermal energy [1] before being carried away by the body.

(d) Radio waves have low frequency, long wavelength or low energy and this makes it not so penetrating.

(e) Sound energy / thermal energy / light energy – Any one. [1]

(f) Keep phone at a distance; use headphone or switch off hand set; make brief calls only; direct antenna away from head, etc. (Any one) [1]

(g) $\lambda = c / f$
$= 3.0 \times 10^8 \text{ m s}^{-1} / 1200 \times 10^6 \text{ Hz}$
$= 0.25 \text{ m}$ [1]
Length of antenna $= 0.25 / 4$
$= 0.0625$
$= 0.063 \text{ m}$ [1]

(h) Gamma ray *I* X-rays *I* UV (any one) that damage/mutate/ionize body cells. [1]

12B(a)(i) Polystyrene is a poor thermal conductor so less thermal energy is conducted away from the hot water to the outside environment [1].
The lid reduces the heat loss as it cuts down the evaporation of hot water [1]. The lid reduces heat loss as it does not encourage the setting up of convection current in the air above the water surface [1].

(ii) The exterior of the polystyrene cup could be coated with silver paint / wrapped with a shiny silver aluminium foil [1] (silvery surface is a poor emitter of radiant heat.)
[1]) or lagged with Styrofoam, or any appropriate material with air pocket [1] (air is a poor thermal conductor [1]).

(iii) To facilitate the creation of convection currents in the water so as to heat the water efficiently / less time to heat up the water / less energy to heat up the water [1].

(b)(i) Water has reached its boiling point so temperature remains constant [1].

(ii) Specific heat capacity / heat capacity of copper is significantly lower / lower than that of water [1].

(iii) $m \times 4200 \text{ J / (kg } ^\circ\text{C)} \times (95.0 - 6.0) \ ^\circ\text{C} = 6.5 \times 10^9 \text{ J / min}$ [1]
$m = 1.7 \times 10^4 \text{ kg / min}$ [1]