Catholic High School | O-Level Physics
6091 Nov 2018
Suggested Answers

NOT IN SYLLABUS:	
P1:	-
P2:	-

Paper 1 [40 marks]

1	**B**	11	**A**	21	**D**	31	**A**
2	**D**	12	**B**	22	**B**	32	**A**
3	**C**	13	**D**	23	**C**	33	**A**
4	**C**	14	**C**	24	**B**	34	**A**
5	**C**	15	**C**	25	**D**	35	**D**
6	**B**	16	**D**	26	**B**	36	**C**
7	**A**	17	**A**	27	**B**	37	**D**
8	**C**	18	**A**	28	**D**	38	**B**
9	**A**	19	**B**	29	**B**	39	**B**
10	**A**	20	**D**	30	**C**	40	**C**

***Q. 9:** **A** This question tested the way in which the gravitational fields of the Earth and the Moon interact. It is a commonly held, but erroneous view that beyond the Earth's atmosphere, objects no longer experience a gravitational force due to the Earth.
(B is incorrect.)

***Q. 12:** **B** Both of the forces referred to in the question are one force of a Newton's third law pair and it is necessary to be clear which of the two forces, in each case, is the one being asked for. Confusion with this led to the selection of any of the three incorrect options.

***Q. 15:** **C** The question concerns the energy transfer that is taking place as the stone slows down as it moves downwards in the water. Both the kinetic energy and the gravitational potential energy are decreasing during this time.
(A and B are incorrect.)

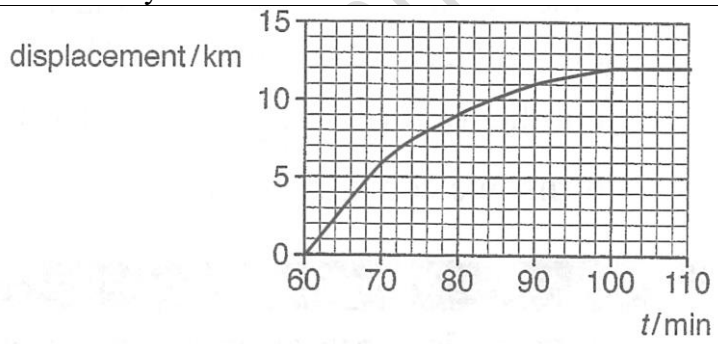
***Q. 21:** **D** Convection in air can only transfer heat upwards. Consequently, the options that include convection could not be correct. The question states that the temperature of the air is greater than that of the ice and so there will also be some transfer of heat by radiation. Thermal radiation from gases must be considered.

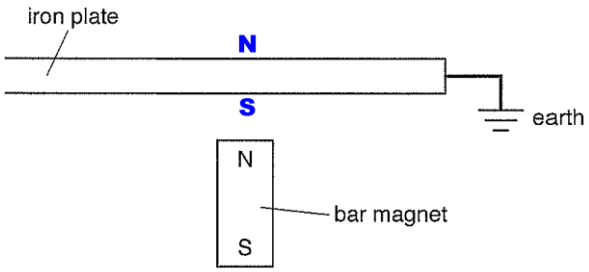
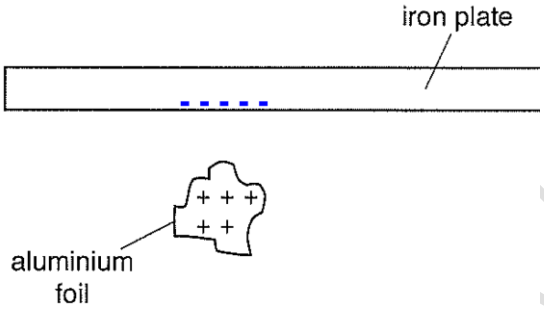
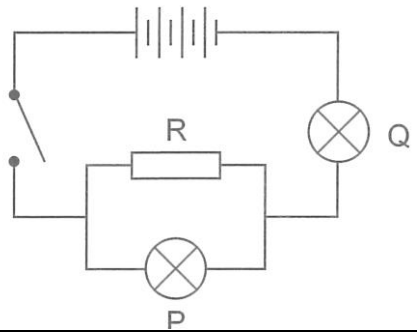
***Q. 30:** **C** It is commonly understood that the resistance of the circuit decreased, and deduced from this that the current supplied by the cell and hence the current in the lamp, increased – thus an increased potential difference across the lamp was often successfully chosen. As there are two significant potential differences in the circuit – one increases whilst the other decreases – it is easy to be confused.
(A is incorrect.)

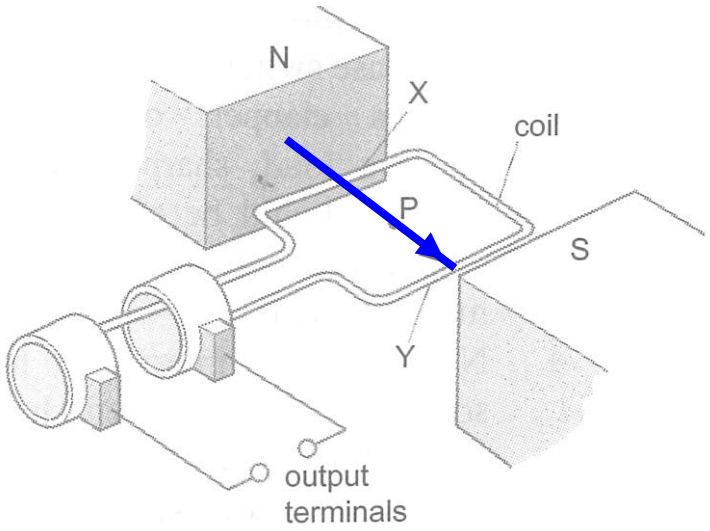
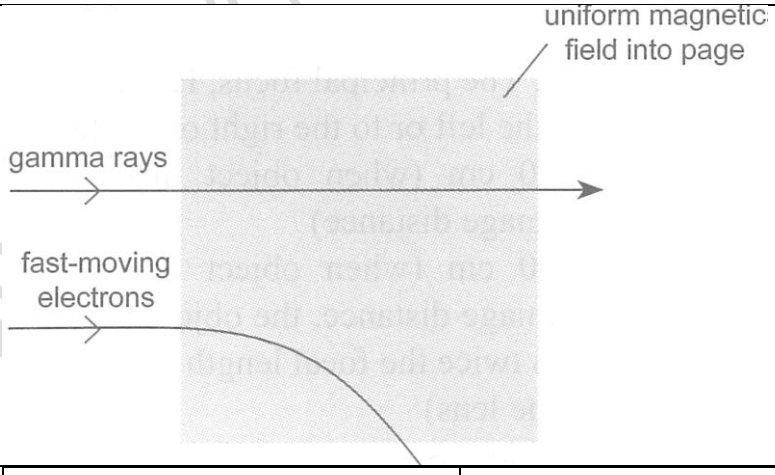
***Q. 32:** **A** This question tested both factual knowledge and one consequence of the fact. Most are aware that a voltmeter measures the potential difference between the two terminals of the component with which it is connected in parallel. The question makes clear that the voltmeter does not affect the current and it is wrong to interpret this to mean that the resistance of the voltmeter had to be small.
(B is incorrect.)

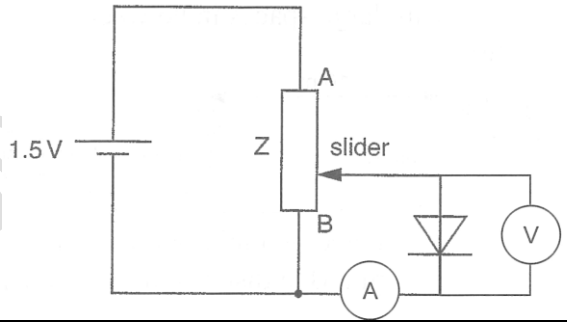
***Q. 33:** **A** (B and C are incorrect.)

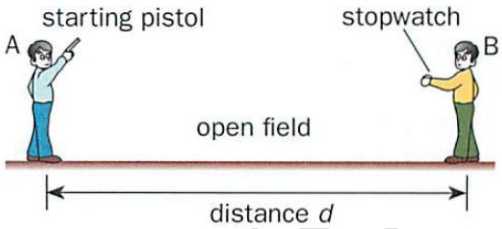
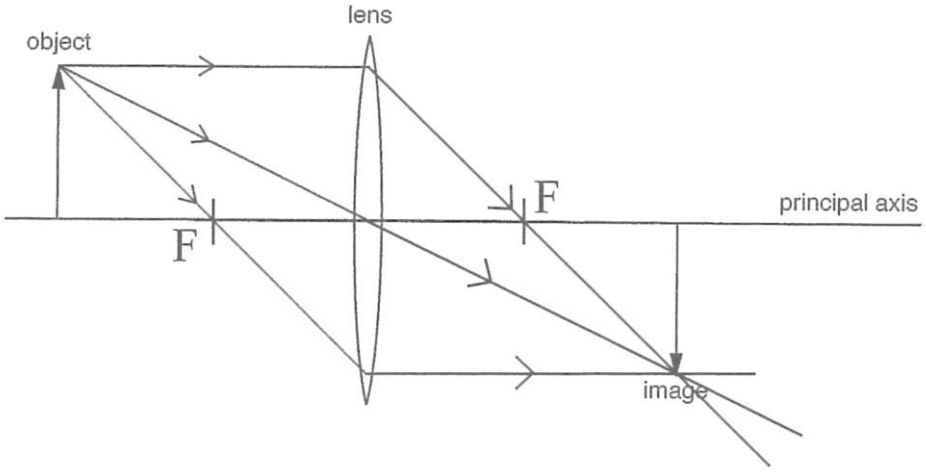
Paper 2 [80 marks]

1	ai	The value on the main scale is 7.50 mm, and should be added to 0.48 mm on the rotating scale.	1 1
	aii	Action: Close the jaws of the micrometer completely. Reason: To check for and subtract away the zero error. OR: Action: Take average of diameters at different positions along cylinder. Reason: The cylinder may not be uniformly shaped. [Note: 'Precaution' = 'Action' + 'Reason']	1
	b	Diameter of cylinder = 7.98 mm = 0.798 cm Volume of cylinder = $\pi(\frac{d}{2})^2 l$ = $\pi\left(\frac{0.798}{2}\right)^2 (2.6)$ cm^3 Density = $\frac{\text{Mass}}{\text{Volume}} = \frac{3.5}{\pi\left(\frac{0.798}{2}\right)^2 (2.6)}$ = <u>2.69 g/cm^3</u> (3 s.f.)	 1 1 1
2	a	$F_r = ma$ $(2.5 \times 10^5) - (1.2 \times 10^5) = (1.5 \times 10^6)a$ a = <u>0.0867 m/s^2</u> (3 s.f.)	 2 1
	b	The force acting forwards on the tanker due to the propellers is constant, but the drag force acting on the tanker increases with speed. Thus the resultant force acting on the tanker decreases and the acceleration decreases by Newton's Second Law.	1 1
	ci		2
	cii	The gradient of the displacement-time graph, which gives the velocity, is decreasing.	1
3	a	Kinetic energy, K.E. = ½mv^2 = ½(60)(2.5)^2 = <u>188 J</u> (3 s.f.)	1 1
	bi	There is friction between the slide and the child. Hence, the child slows down and the kinetic energy is converted to thermal energy (internal energy) of the child and the slide.	1 1
	bii	Internal energy is the sum of the potential and kinetic energies of all the molecules in a body.	1
	biii	There is no height difference between X and Y.	1
4	a	The air molecules are in constant, random motion.	1
	b	The air molecules collide with the sides of the containers and exert a force on them. This creates a force per unit area, which is the pressure on the sides.	1 1

		The pressure is large due to the large number of air molecules colliding with the slides.	1
5	a	 Due to magnetic induction, the bottom of the iron plate becomes an induced South pole and the top becomes an indcued North pole. As the force of attraction between unlike poles is larger than the force of repulsion between like poles, there is a net attractive force between the magnet and the iron plate.	 1 1
	b	 Due to electrostastic induction, electrons flow from the earth to the bottom of the iron plate. Unlike charges attract, so the foil moves towards the iron plate.	 1 1
	c	Both the aluminuim foil and the iron plate are electrical conductors. Hence, electrons on the iron plate flow to neutralise the positive charges on the aluminuim foil.	1 1
6	a		2
	b	$R_P = V \div I = 1.5 \div 0.25$ $= \underline{6.00\ \Omega}$ (3 s.f.)	1 1
	c	$\left(\frac{1}{R_P} + \frac{1}{R_R}\right)^{-1} + R_Q = 12$ $\left(\frac{1}{6.00} + \frac{1}{18}\right)^{-1} + R_Q = 12$ $R_Q = \underline{7.50\ \Omega}$ (3 s.f.)	 1 1
	di	The current splits to flow through resistor R and lamp P, before joining to flow through lamp Q.	1

	dii	As the current that flows through lamp Q is higher, it has a higher temperature. Thus the resistance of lamp Q increases as filament lamps are non-ohmic.	1 1
7	a		1
	bi	As the coil rotates, the magnetic flux linking the magnet and the coil is changing. According to Faraday's Law of Electromagnetic Induction, an electromagnetic force (e.m.f.) is induced in the coil.	1 1
	bii	C	1
	biii	The coil is in the vertical position, with side X above side Y.	1
	c	The output current from the a.c. generator is constantly changing in both direction and magnitude, but the current from a battery is constant in both direction and magnitude.	1
8	a	1. The particle must be charged. 2. The particle must be moving in a direction not parallel to the magnetic field.	1 1
	b		3
9	a	**Boiling** / **Evaporation** Occurs at particular temperature / Occurs at any temperature Relatively fast / Relatively slow Takes place throughout liquid / Takes place only at surface liquid Bubbles are formed / No bubbles are formed Temperature remains constant / Temperature may change External thermal energy source / No external thermal energy source	2

	bi	$Q = ml_v$ $2.3 \times 10^6 = m(2.4 \times 10^6)$ Mass of water lost by evaporation in 1 hr, m = <u>0.958 kg</u> (3 s.f.)	 1 1
	bii	Energy gained by body in one hour = $3.2 \times 10^8 - 2.3 \times 10^6 = 9.0 \times 10^5$ J $Q = mc\Delta\theta$ $\Delta\theta = Q \div mc = 9.0 \times 10^5 \div (70)(3500)$ = <u>3.67 °C</u> (3 s.f.)	1 1 1
	biii	The rise of 3.67 °C will cause the average body temperature to be 37 + 3.67 = 40.67 °C, which will be higher than 40 °C.	1
	biv	Energy lost by vaporisation when the runner exhales in 1 hr = $3.2 \times 10^6 - 2.3 \times 10^6 = 9.0 \times 10^5$ J The **whole** race takes 3.5 hrs. Total energy loss in 3.5 hrs = $(9.0 \times 10^5) \times 3.5 = 3.15 \times 10^6$ J $Q = ml_v$ $3.15 \times 10^6 = m(2.4 \times 10^6)$ Mass of water vapour exhaled in 3.5 hr, m = <u>1.31 kg</u> (3 s.f.)	 1 1
	bv	From (b)(i): mass of water lost by evaporation in 1 hr = 0.958 kg From (b)(iv): mass of water vapour exhaled in 3.5 hr = 1.31 kg Total mass of water lost = 1.31 + 3.5(0.958) = 4.663 kg Percentage of body mass lost by evaporation = (4.663 ÷ 70) × 100% = 6.67% (> 5%) The runner suffers from severe dehydration.	 1 1
10	a	Potentiometer (OR: Potential divider)	1
	b		2
	ci	From 0 to 0.54 V, the current is zero, and the resistance of the diode is infinite/ very high. From 0.56 to 0.70 V, the current increases at an increasing rate with respect to voltage, and the resistance of the diode decreases.	1 1
	cii	$P = IV$ = (42 mA)(0.76 V) = <u>32 mW</u> (2 s.f.)	1 1

		[Note: Values from a graph with grid should be read to half a smallest division (ie. *V* should be read to 2 d.p.). Hence P is given to 2 s.f. due to least s.f. rule.]	
	d	If the student moves the slider from A, the initial potential difference across the diode will be 1.5 V and the diode will overheat and stop working.	1
11 E	a	• Sound is a longitudinal wave while light is a transverse wave. • Sound needs a medium to travel in while light can travel in a vacuum.	1
	b	3×10^8 m/s	1
	ci	Refractive index of glass = $\frac{\text{Speed of light in vacuum}}{\text{Speed of light in glass}}$	1
	cii	The refractive index of glass is larger than 1.	1
	d	The particles in glass are closer together than in air. When disturbed at one end, the particles in glass will vibrate faster and collide more easily with the surrounding closer particles.	1 1
	e	[Note: Can use either direct method or echo method.]  1. Measure the distance, *d* between persons A and B. 2. B will start the stopwatch when he sees the smoke/spark from the pistol fired by A. 3. B will stop the stopwatch when he hears the sound from the pistol, and record the time taken, *t*. 4. Speed of sound in air = $\frac{\text{Distance, } d}{\text{Time, } t}$	1 1 1 1
11 Or	a	Focal length is the distance between the optical centre of the lens and the focal point/ principal focus. The focal point/ principal focus is the point on the principal axis, where rays parallel to the principal axis will converge after passing through the lens. [Note: For 2 marks, there is also a need to define 'focal point/ principal focus' within the definition for 'focal length'.]	1 1
	bi, ii	 [Note: mark the position of either F.]	2
	ci	40 cm [Note: when distance of object = distance of image = 40 cm.]	1

	cii	focal length = 20 cm [Note: distance of object = distance of image at 2F]	1
	d	The new position of the object is between the focal length and two times the focal length (between F and 2F).	
	e	1. Virtual 2. Upright 3. Magnified 4. Same side of the lens as the object	3 Any three