

2020 Physics 6091/01 Answer Key

Qn	Ans	Explanation
1	C	Mega metres = 10^6 m Millimetres = 10^{-3} m Thus, conversion of millimetres to Megametres = $10^6/10^{-3} = 10^9$
2	C	Atom diameter is measured in nanometers, While earth's diameter is measured in Megametres.
3	B	If object O is stationary, it is in equilibrium and therefore forces acting on it cancel each other out. The only force that X could be that would produce a 5N force acting to the top left would be 3N as by Pythagoras theorem, $\sqrt{3^2+4^2} = 5$
4	C	A and B are incorrect as gravitational field and hence acceleration due to free fall are not dependent on mass. D is incorrect as air resistance is dependent on size and shape of the object, not the mass. C is correct as the metal ball has a higher mass(hence higher weight) and thus will need to hit a higher speed before air resistance can match the rate.
5	D	Terminal velocity = gradient of graph when gradient becomes constant. = $(3-0)/(1-2.5) = -2.0\text{m/s}$
6	B	If only front wheels are being driven by engine, Front wheels are rotating clockwise, thus the bottom of the wheel is moving to the left and so friction will act to the right. The back wheels will be dragged forward, and thus the motion of the wheel (not rolling but dragging) is to the right, and so the friction would act to the left(causing the wheel to then rotate)
7	A	Since they are both copper, they will be made of the same material and hence have the same density.
8	D	Actual volume of metal = mass/density = $15/3 = 5\text{cm}^3$ Volume of metal(including space) = $4 \times 4 \times 4 = 64\text{cm}^3$ Therefore, empty space = $64-5 = 59\text{cm}^3$

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9	D	Using POM, CW moment = CCW moment $F \times 0.3 = 24 \times 0.5$ $F = 40\text{N}$ Total Upward force = total downward force Force exerted by shoulder = Force of hand + Weight of Load $= 24 + 40 = 64\text{N}$
10	A	Base of each brick = $0.2 \times 0.1 = 0.02\text{m}^2$ A: $P = 32 \times 10\text{N} / 8 \times 0.02 = 2000\text{Pa}$ B: $P = 30 \times 10\text{N} / 6 \times 0.02 = 2500\text{Pa}$ C: $P = 36 \times 10\text{N} / 12 \times 0.02 = 1500\text{Pa}$ D: $P = 54 \times 10\text{N} / 9 \times 0.02 = 3000\text{Pa}$
11	A	For $P = h(\rho)g$, h is the vertical height of the water level. Rho is the pressure of the liquid. Thus, pressure of air = pressure measured by liquid = ldg
12	D	Some energy is lost to air resistance, thus, K will be less than P. POCOE is always obeyed.
13	D	Work done = Force x distance = $3600 \times 100 = 360\,000\text{J}$
14	A	GPE increase = $mgh = W \times h = 20 \times 3 = 60\text{J}$ Work done = $F \times d = F \times 5\text{m}$ (Pythagoras theorem) As Work done needs to be at least equal to GPE, $5F = 60\text{J}$ $F = 12\text{N}$
15	C	Since temperature remains constant, KE and hence speed of particles should be the same. However, there is now more space(less particles per unit volume) in the syringe, and thus piston is hit less frequently and pressure decreases.
16	D	Heat through the glass is via conduction. Only valid answer should refer to the vibration of the particles.
17	A	The mass of a substance will not change due to temperature changes.

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18	B	Volume of water = $12 \times 8 \times 1.2 = 115.2\text{m}^3$ Mass of water = $115.2 \times 1000 = 115200\text{kg}$ Total energy required = $115200 \times 4200 \times (29-20) = 4.354 \times 10^9$ Power = $E/t = 4.354 \times 10^9 / (24 \times 60 \times 60) = 50400\text{W} = 50\text{kW}$
19	D	Time taken to freeze = $150-50 = 100\text{s}$ Energy extracted = $100 \times 200 = 20\,000\text{J}$ Specific latent heat = $20000 / 50 = 400\text{ J/g}$
20	C	Since specific heat capacity is the amount of energy required to increase a single unit mass by 1 degree, Ratio = $1\text{g} / 2\text{g} = 1/2$
21	D	Sound(including ultrasound) are longitudinal. All EM waves(including light) are transverse.
22	A	Wavelength is the distance between two compressions, thus wavelength equals 12cm. Since a point moves between two positions, the amplitude is the distance from the centre of the two positions to either of the positions, thus = $1\text{cm}/2 = 0.5\text{cm}$
23	D	Freq = velocity / wavelength = $1400\text{m/s} / (0.7 \times 10^{-3})\text{m}$ $= 2 \times 10^6\text{ Hz}$
24	B	As object moves closer to lens, ray of light passing through optical centre moves away from the centre line and thus, image formed is further and becomes larger. (ie compare when $O = 2F$ to O between $2F$ and F .)
25	C	Angle of refraction and critical angle is always between the ray and the normal.
26	B	In space, there is no medium for sound to travel. Thus, B cannot have sound waves.
27	C	Louder = higher amplitude Lower pitch = lower frequency = higher period Only graph that matches is C

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28	A	Due to the earth wire, all negative electrons will be repelled down the earth wire due to the presence of the rod. Thus, the sphere should become entirely positively charged.
29	B	Electron flow is always opposite to conventional current, thus it moves from right to left. Charge flowing per second = $Q = It = 0.32C$ Therefore, total number of electrons = $0.32C / (1.6 \times 10^{-19})$ $= 2 \times 10^{18}$ electrons
30	C	C has 5 batteries with positive to the left and one with positive to the right. This means the total emf will be $5 \times 1.5 - 1.5 = 6.0V$
31	B	$I = Q/t = 15/10 = 1.5A$ $V = \text{Energy} / Q = 60 / 15 = 4V$
32	C	Due to reading of 2A in the second ammeter, total resistance of each branch of the parallel circuit is equal. $R \text{ of } X = R \text{ of } Y + 3$ Only combination that fits will be if $X = 6\text{ohm}$ and $Y = 3\text{ohm}$
33	C	Current when at room temp = $1.8V / 2000 = 0.0009A$ Total emf = $I \times \text{total resistance} = 0.0009A \times (2000+6000)$ $= 7.2V$ When thermistor is now 2.0kOhm $V = R1 / R_{\text{total}} \times V_{\text{total}}$ $= 2.0/(2.0+2.0) \times 7.2V$ $= 3.6V$
34	D	Fuse is always located at the live wire. The main purpose of a fuse is to open the circuit in the case of a short circuit, and thus prevent the circuit from remaining live(causing danger of electrocution).
35	C	The north pole of a magnet always points to the Geographic north pole of the earth(the poles of the earth do not refer to its magnetic poles).
36	C	To demagnetize a magnet, you will need an alternating current connected to a coil. A direct current will not be able to demagnetize the magnet.

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37	B	Using Fleming's Left hand rule, The induced force will only act upward.
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Questions 38 – 40 have been removed from the 2020 syllabus.