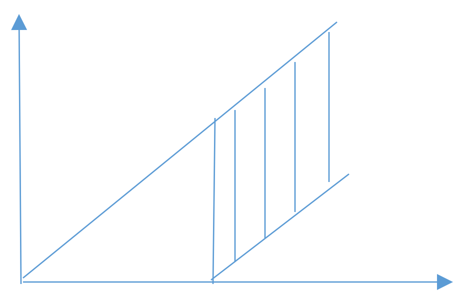
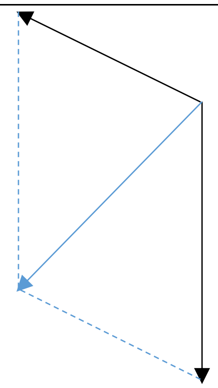
4 E PRELIM P1 ANSWERS

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

Explanations:

1	B	Unit of Angular momentum = unit of mass x unit of velocity x unit of radius = kg ms^{-1} m = kg m^2s^{-1}
2	B	Method 1: Distance between two stones = Distance travelled by the first stone – distance travelled by the second stone = $\frac{1}{2}gt^2 - \frac{1}{2}g(t-5)^2$ = $\frac{1}{2}g(10t + 25)$ Since 10t+ 25 increases with t, the distance between the two stones will also increase with time. Method 2:  Consider the v-t graph of the two stones above. The shaded area represents the distance between the two stones, which increases as time passes.
3	A	Constance force ≡ constant acceleration. The velocity time graph has a constant gradient.
4	B	By conservation of energy: Loss in GPE = Gain in KE mgh = ½ mv^2 10 x 0.21 = ½ v^2 v = 2.0 ms^{-1}

5	B	
6	D	Since the car is moving with constant speed, the net force on the car is zero. Since there is no additional external forces acting on the car as the sand spills, the net force remains at zero. Hence, there is no change in the acceleration of the car.
7	A	After force F is removed, the net force on the block will be equal to the frictional force acting against the motion of the block. Hence, there will be a negative acceleration which slows the block down.
8	B	Force on hand by book = force on book by hand = 30 N Force on book by ceiling = Force on ceiling by book = F- Weight of book = 10 N
9	C	W = mg
10	C	Taking moments about P, By principle of moments, Sum of CW moments = Sum of ACW moments W_{board} x 1.5 m = F x 2m F = $\frac{60\times10\times1.5}{2}$ = 450 N
11	D	Loss in GPE = Gain in KE + Work done against friction 50 J = Gain in KE + 20 J Gain in KE = 50 – 20 = 30 J ½ $m(v_2^2 - v_1^2)$= 30 J $v_2^2 - v_1^2 = \frac{30\times2}{50}$ = 1.2 $v_2^2 = 1.2 + 3.0^2 = 10.2$ $v_2 = 3.2\ ms^{-1}$
12	D	The time taken for each person is needed.
13	D	$$\frac{150\ N}{5.0} = \frac{Load}{100}$$ Load = 3000 N
14	C	Let the pressure on the air column in the horizontal position and vertical position be $p_{horizontal}$ and $p_{vertical}$ respectively. At the same temperature, $\frac{P_{horizontal}}{P_{vertical}} = \frac{V_{vertical}}{V_{horizontal}} = \frac{18}{20} = \frac{9}{10}$ $P_{vertical} = \frac{10}{9} P_{horizontal} = \frac{10}{9}$ p

		Pressure by the mercury column on the trapped air = $p_{vertical}$ - p= $\frac{10}{9}$ p- p = $\frac{1}{9}$ p
15	D	$\frac{100°C-80°C}{80°C-20°C} = \frac{28cm-24cm}{24cm-h}$ h = 12.0 cm
16	C	KE of a gas represents the average speed of the gas molecules.
17	A	As the temperature of the gas increases, the average KE of the gas molecules also increases. This causes gas molecules to collide more forcefully and more frequently against **the walls of the container**. This causes an increase in both force per collision AND frequency of collision.
18	C	Since the water below must be warmer than the ice, convection will only happen from the water at the bottom to the water on top surrounding the ice, and conduction of thermal energy should be from the water to the ice. However, if the ice is found to be thickening at the lower surface of the ice, it indicates that thermal energy is transferred away from the ice. Hence, the process involved should be conduction from the lower surface to the upper surface, since the lower surface of ice is not in direct contact with air.
19	D	White surfaces are poor absorbers of infrared radiation, hence the percentage of energy reflected is the highest, as compared to black surfaces which are good absorbers.
20	D	As thermal energy is no longer supplied to the pot, the loss in thermal energy from the porridge through the pot to the surroundings will cause the temperature of the porridge and the pot to decrease. As the pot has high heat capacity, its temperature will not drop too fast with heat loss, allowing the porridge to remain at high temperature for a longer time.
21	B	Thermal energy needed to melt the ice Q = 336 x 5.0 = 1680 J Energy that the water lost to the ice at 0°C = 1680 = 4.2 x mass of water x (100 – 0) Mass of water = $\frac{1680}{4.2 \times 100}$ = 4.0 g
22	B	TIR can happen as a light ray travels from an optically denser medium (higher refractive index) to an optically less dense medium (lower refractive index), when the angle of incidence is larger than the critical angle of the optically denser medium.
23	A	When u = 400 mm: v = $\frac{1}{\frac{1}{150}-\frac{1}{400}}$ = 240 mm When u = 300 mm: v = $\frac{1}{\frac{1}{150}-\frac{1}{300}}$ = 300 mm

		The screen should move away from the lens a distance of 300 -240 = 60 mm
24	A	Sonar technology uses sound waves.
25	A	Frequency of the waves is constant. Since *v = fλ*, when v increases, wavelength increases as the waves enter rock type 2. Hence, the distance between the wavefronts should be larger in rock type 2. Since the waves travel faster in rock type 2, the waves should be refracted away from the normal in rock type 2.
26	B	
27	A	Magnetic field strength is represented by how close the magnetic field lines are.
28	B	As the positively charged sphere is brought near to X, electrons move from the furthest side of Z to the side of X that is nearer to the rod, making X negatively charged and Z positively charged. Y is neutral as the negative charges will concentrate on the surface of X nearest to the glass rod, and the positive charges will concentrate on the surface of Z furthest from it.
29	B	At 9.0 V, the charge is at equilibrium. Its weight W = electrostatic force between the negative charge and the upper positive plate. As the potential difference is increases, the electrostatic force will also increase, resulting in a net force in the upward direction. Since F = ma, the charge will accelerate upwards.
30	C	Electrons are the particles moving around in the circuit. Em.f = W/Q = 750/100 = 7.50 V
31	D	*I = Q/t*
32	B	Current is the same at every part of the conductor, so (i) is false. R = $\frac{\rho L}{A}$, which is inversely proportional to cross sectional area. The section with half the cross sectional area has twice the resistance.
33	B	$R_{eff} = (\frac{1}{R_1} + \cdots \frac{1}{R_n})^{-1}$ $R_{PQ} = (\frac{1}{1} + \frac{1}{9})^{-1} = 0.9$ $R_{QS} = (\frac{1}{5} + \frac{1}{5})^{-1} = 2.5$ $R_{RS} = (\frac{1}{3} + \frac{1}{7})^{-1} = 2.1$ $R_{SP} = (\frac{1}{4} + \frac{1}{6})^{-1} = 2.4$
34	B	P = $\frac{V^2}{R}$ Given that the heating elements are identical, the series ciruit has the highest Reff while the parallel circuit has the lowedst Reff. With the same V, the higher Reff, the lower the rate of energy conversion to thermal energy, hence the lower the power.
35	C	Since the bulbs are connected in parallel with the emf, their brightness will only be affected by the emf (P = $\frac{V^2}{R}$).

36	C	A DC current has a fixed direction and magnitude, hence it will not be able to demagnetise a permanent magnet.
37	C	NS attracts both ends of YX. Hence, YX is a magnetic material, not a magnet. The S pole of NS repels Q of PQ. Hence, PQ is a magnet and Q is S pole as like poles repel. P is N pole.
38	C	Using Fleming's LHR, with current direction from right to left and field direction into the page, the direction of the force on the charges is downwards.
39	C	The generator rotates at half the original speed → the frequency of the sinusoidal waves will also be halved. By Faraday's Law of Electromagnetic Induction, the induced emf is directly proportional to the rate of change of magnetic flux, which is halved as frequency is halved. Hence, the resultant waves will have double the period and half the amplitude.
40	B	$\frac{V_{secondary}}{V_{primary}} = \frac{N_{secondary}}{N_{primary}}$ $\frac{V_{secondary}}{240\ V} = \frac{N_{secondary}}{N_{primary}}$ For an ideal transformer, $I_{secondary}V_{secondary} = I_{primary}V_{primary}$ $V_{secondary}$ = (0.1 A x 240 V)/2.0 A = 12 V Hence, $\frac{N_{secondary}}{N_{primary}} = \frac{12}{240} = \frac{1}{20}$